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Master Project Facilities Plan, Expansion of Reno-Sparks Joint Water Pollution Control Plant Cities of Reno and Sparks, Nevada

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16. Abstract (Limit: 200 words)

The purpose of the Master Project Facilities Plan, Expansion of Reno-Sparks Joint Water Pollution Control Plant (JWPCP), is to determine the optimum method of increasing the capacity of the existing wastewater treatment plant serving the cities of Reno and Sparks. The expansion of the JWPCP from 20 mgd to 30 mgd under the Early Start Program (ESP) is nearly complete. The effluent will continue to be discharged to the Truckee River/ The Master Project Facilities Plan encompasses the expansion of the ESP JWPCP facilities from 30 mgd to 40 mgd to accommodate projected growth until about year 2000.

The Facilities Plan analyzed a number of alternatives incorporating several treatment and effluent disposal concepts. Summary descriptions of existing facilities and Master Project alternatives are given.

It is concluded in this Draft EIS that the potential for significant adverse impacts exists with all JWPCP alternatives as presently proposed in the cities' Facilities Plan.

The purpose of this Environmental Impact Statement is to publicly present all of the issues surrounding the project and its objectives, so they can be resolved as openly and satisfactorily as possible.

17. Document Analysis a. Descriptors

Sewerage
Wastewater Treatment
Wastewater Disposal
Sludge Disposal

Environmental impact statement

b. Identifiers/Open-Ended Terms

Reno, NV
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PB82-185786

Draft Environmental Impact Statement

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

MASTER PROJECT FACILITIES PLAN

Expansion of Reno-Sparks Joint Water Pollution Control Plant

Cities of Reno and Sparks, Nevada

REPRODUCED BY
NATIONAL TECHNICAL INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
RENO-SPARKS JOINT WATER POLLUTION CONTROL PLANT MASTER PROJECT

Prepared by:

U. S. Environmental Protection Agency
Region IX
215 Fremont Street
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September 15, 1980

Grant Number
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Responsible Official

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EXECUTIVE SUMMARY
ENVIRONMENTAL IMPACT STATEMENT

DRAFT (X)

FINAL ( )

Prepared By: U. S. Environmental Protection Agency
Region IX
215 Fremont Street
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Type of Action: Administrative

Description of Project

The purpose of the *Master Project Facilities Plan, Expansion of Reno-Sparks Joint Water Pollution Control Plant* (JWPCP), is to determine the optimum method of increasing the capacity of the existing wastewater treatment plant serving the Cities of Reno and Sparks. The expansion of the JWPCP from 20 mgd to 30 mgd under the Early Start Program (ESP) is nearly complete. The effluent will continue to be discharged to the Truckee River. The *Master Project Facilities Plan* encompasses the expansion of the ESP JWPCP facilities from 30 mgd to 40 mgd to accommodate projected growth until about year 2000.

The Facilities Plan analyzed a number of alternatives incorporating several treatment and effluent disposal concepts. Summary descriptions of existing facilities and Master Project alternatives are given in Chapters 2 and 3. The alternatives deemed most feasible after the initial screening were evaluated in depth in the Facilities Plan, and they include six advanced wastewater treatment (AWT) options with continuation of discharge to the Truckee River; two secondary treatment alternatives involve land discharge at Dodge Flat; and one alternative would discharge to the Truckee Canal. These alternatives will expand the JWPCP capacity from 30 mgd to 40 mgd, and they are briefly described below.

AWT and Direct Discharge to the River

T-5: Wastewater would receive secondary treatment with PhoStrip phosphorus removal, fluidized bed nitrification/

denitrification, gravity filtration, chlorination and dechlorination using sulfur dioxide. Effluent discharge would be to the Truckee River at one of three locations.

T-6a: Wastewater would receive secondary treatment with PhoStrip for phosphorus removal, activated biological filtration for nitrification, an anaerobic reactor for denitrification, gravity filtration, chlorination, and dechlorination using sulfur dioxide. Effluent discharge would be to the Truckee River.

T-9: Wastewater would receive secondary treatment with PhoStrip phosphorus removal, gravity filtration, ion exchange ammonia removal, chlorination, and dechlorination with sulfur dioxide. Effluent discharge would be to the Truckee River.

T-12: Wastewater would receive secondary treatment with PhoStrip phosphorus removal and trickling filters and trickling filters enclosed in an anaerobic reactor for nitrification and denitrification, respectively. Effluent would be chlorinated and dechlorinated, with disposal to the Truckee River.

T-14a: Wastewater would receive secondary treatment with nitrification provided by an activated biological filter (as in T-6a), denitrification would be provided in a subsequent fluidized bed denitrification reactor (as in T-5), PhoStrip phosphorus removal and side-stream flow equalization prior to denitrification. Effluent would be chlorinated and dechlorinated with disposal to the Truckee River.

T-15: Wastewater would receive secondary treatment with PhoStrip phosphorus removal, nitrogen removal by a combination of the trickling filter nitrification concept used in Alternative T-12 and the fluidized bed concept used for denitrification in Alternative T-5, gravity filtration and chlorination and dechlorination using sulfur dioxide. Effluent disposal would be to the Truckee River.

Secondary Treatment Discharge to Land

L-6: Wastewater would receive secondary treatment only. Side-stream flow equalization facilities would be added after the chlorination facilities. A pipeline would carry the secondary effluent to Dodge Flat, where it would be used for agricultural irrigation during the summer months and for groundwater recharge (rapid infiltration) during the winter months.

L-7: Wastewater would receive secondary treatment only. All effluent would be conveyed by gravity pipeline to the Dodge Flat area, where it would be utilized during the summer for irrigation. During the winter, it would be diverted through a new gravity pipeline to the Fernley drain.

Secondary Treatment With Phosphorus Removal and Filtration, Discharge to Truckee Canal

L-1: Wastewater treatment would consist of secondary treatment, phosphorus removal by the PhoStrip process, gravity filtration and chlorination. A gravity pipeline would be constructed from the Joint Water Pollution Control Plant to the Truckee Canal immediately below Derby Dam. Just below Derby Dam, effluent would be discharged to the Truckee Canal on a continuous year-round basis.

The Facilities Plan Alternative L-1, AWT treatment and Truckee Canal disposal, is the cities' preferred alternative.

Sludge Disposal at Spanish Springs Valley

Alternative S-12 was selected from among 21 sludge disposal alternatives for implementation by the Cities of Reno and Sparks. Liquid sludge would be pumped from the JWPCP through an 8-inch force main to a 460-acre site in Spanish Springs Valley that will be dedicated to sewage sludge disposal. Liquid sludge will be sprayed on 255 acres using center-pivot irrigation systems.

Environmental Considerations Relative to the Selection of the Reno-Sparks JWPCP Master Project

The Draft Facilities Plan prepared for Reno and Sparks by Kennedy/Jenks (1980) recommends the implementation of Alternative L-1, secondary treatment plus phosphorus removal and filtration with discharge to the Truckee Canal. Obviously, implementation of Alternative L-1 or any of the other alternatives results in major environmental resource, social, and economic trade-offs of importance to many interested agencies and parties. Comments on the Draft EIS and Draft Facilities Plan are expected to elucidate the significance and value of these trade-offs, and focus the governmental grant funding and regulatory process on the actions required to implement a project.

The affected environment and no-action alternative conditions are described in Chapter 4. The environmental impacts of the three major Master Project wastewater treatment and disposal alternatives and the proposed sludge conveyance and disposal project are identified and discussed in Chapter 5. The alternative projects provide distinctly different sets of environmental, cost, and institutional conditions from which to select an implementable Master Project. The options to achieve similar goals are wide ranging and complex, creating benefits and detriments to numerous special interests. Consequently, the selection of a 40 mgd Master Project will require natural resource and economic trade-offs that are unique to the Truckee-Carson River basins. Potential mitigations for significantly adverse impacts are also identified in Chapter 5. Mitigations leading to generally acceptable trade-offs depend on many decisions outside the purview of the EPA. Moreover, many of the required decisions are presently clouded by litigation and local customs.

The principal impacts of the Master Project, in common and as distinct alternatives, are summarized for comparative purposes in Table S-1. The wastewater treatment and disposal alternative that seems to best resolve each stated issue for a resource category is also given in the table. The alternatives were selected to respond differently to the major issues, and of course, none provides a clearcut resolution to even a majority of these issues.

Impacts Common to the Master Project

The Draft EIS is a response to the recommended project and major alternatives to that project. There are a number of significant environmental resource and socio-economic impacts common to the increase in wastewater treatment and disposal capacity from 30-40 mgd. Some of these common impacts are adverse, and potential mitigations are identified, but not necessarily placed in action programs. For example, urban and recreational growth increase traffic, which increases air pollutant emissions, which could increase the frequency of violations of air quality standards established to protect public health. The EPA, the state, and local government are involved in a program to mitigate the emissions of air pollutants to reduce the frequency of air quality violations. The current Air Quality Maintenance Plan does not account for the total growth that may be accommodated by the Master Project.

Other areas of secondary impact related to growth are the conversion of potentially prime agricultural land to urban land uses, overdraft of groundwater resources, conversion

Table S-1. Summary Comparison of the Environmental Consequences of Alternative Reno-Sparks JWPCP Master Project

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
SURFACE WATER HYDROLOGY					
Effects on river flow downstream of Steamboat Creek	Urban growth and the conversion of irrigated agricultural land to urban uses could potentially reduce the annual river discharge by 0 to 5 percent	Except for secondary growth effect common to all alternatives there is no effect	Reduces annual river discharge at Vista by 8 percent Could reduce low Q_{10} monthly instream flows at Vista up to 65 percent depending on river operation criteria	Reduces annual river discharge at Vista by 8 percent Reduces low Q_{10} monthly instream flows at Vista up to 28 percent depending on river operations criteria	AWT with Truckee River disposal
Effects on flows passing Derby Dam to the lower Truckee River	Same as above	Same as above	Reduces annual average discharge past the dam by 8 percent and reduces low Q_{10} flows by up to 65 percent	Same as above	AWT with Truckee River disposal
Effects on Truckee River discharge to Pyramid Lake	Same as above	Same as above	Reduces annual average discharge to the lake by 9 percent. Could reduce average monthly low Q_{10} flows up to 73 percent	Would not change annual inflow to Pyramid Lake but average monthly low Q_{10} flows could be reduced up to 16 percent. Average monthly flows can increase or decrease depending on river operations from reservoir storage.	AWT with Truckee River disposal
Effects on Newlands Project water demand shortages	No estimated effect	No estimated effect	This option is estimated to increase agricultural demand shortages by 66-71 percent over the river disposal option	Reduces the risk of agricultural water demand shortages in the Newlands Project	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on inflow to Lahontan Reservoir	No estimated effect	No estimated effect	Could reduce amount of flow entering the reservoir but depends on river operations schedule	Produces up to 60 cfs inflow into reservoir during nonirrigation season	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on amount of water reaching Stillwater Wildlife Management Area	No estimated effect	No estimated effect	Estimated to reduce spillage from Lahontan Reservoir by 2-4 percent	Estimated to increase spills from Lahontan Reservoir by 20 percent	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
SURFACE WATER QUALITY					
Abatement of acutely toxic conditions in the Truckee River caused by the JWPCP	All Master Project alternatives remove or abate acutely toxic conditions caused by the JWPCP	At normal JWPCP operations and at river flows exceeding the low Q_{10} conditions acute toxicity is not expected to occur	The JWPCP effluent does not enter the river	Toxic conditions could occur below Derby Dam during treatment plant failures if effluent is released from the canal into the lower river	Secondary treatment and land disposal at Dodge Flat
Abatement of excessive eutrophication of the Truckee River and Truckee Canal	All Master Project alternatives reduce or remove the JWPCP nutrient load	The average daily total nitrogen load is reduced to river by 43 percent and to canal by 42-75 percent. The average daily total phosphorus load is increased to the river by 14 percent	The nutrient load from JWPCP does not directly enter the river; however, some nutrients may enter the river via groundwater accretions downstream of Wadsworth	The JWPCP nutrient load would be removed from the river between Vista and Derby Dam. The total nitrogen load below Derby Dam would be reduced by 22-43 percent. The total phosphorus load below Derby Dam would decrease by 34 percent The total nitrogen load in the Truckee Canal would increase by 122-146 percent The total phosphorus load in the canal would increase by 60-96 percent The Truckee Canal is expected to show symptoms of excessive nutrient enrichment	Secondary treatment and land disposal at Dodge Flat
Effects on dissolved oxygen (DO) in the river between Vista and Derby Dam	All Master Project alternatives reduce substances in the river that could cause depressions in DO	Oxygen consuming BOD and ammonia loads in the river are reduced Algal growth is reduced which in turn reduces the respiratory demand for DO	The BOD and COD load from the JWPCP is removed from the river	The BOD and COD load from the JWPCP is removed from the river between Vista and Derby Dam BOD and COD may be returned to the lower river The BOD load on the Truckee Canal will average 1.09-1.17 mg/l An oxygen sag is expected to occur in the Truckee Canal	Secondary treatment and land disposal at Dodge Flat

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
Effects on chronic toxicity in the river and Truckee Canal	All Master Project alternatives remove or abate chronic toxicity in the river or canal. Nonpoint sources containing potential toxicants are not affected	Through treatment, choice of points of discharge, dilution and the assimilative capacity of the river, potential toxicants in the effluent are reduced to levels that are considered safe for fish as prescribed by the water quality standards There remains a risk for chronic toxicity to occur	The JWPCP which contains toxic substances will not be discharged to the river or canal An undefined level of risk for chronic toxicity to occur in the river will be present from other wastewater discharge sources	Toxic substances in the JWPCP effluent would not enter the river upstream of Derby Dam Toxic substances may enter the lower river by seepage and diversion from the Truckee Canal The level of risk for chronic toxicity to occur in the canal would be high	Secondary treatment and land disposal at Dodge Flat
Effects on bottom sediment characteristics in the river and Truckee Canal	Urban growth and construction is expected to increase the sediment load discharged to the river with surface runoff	Biological growth stimulated by nutrients cause sediments to have a greater content of organic material, higher BOD and lower interstitial DO	The organic component in bottom sediments would be reduced and average interstitial concentrations of DO would rise	Bottom sediments in the canal would have higher BOD and lower DO concentrations	Secondary treatment and land disposal to Dodge Flat
Effects on water temperature in the Truckee River	No common definitive effect	The JWPCP effluent is warmer than the river and may raise the river temperature in the mixing zone by about 1 to 2°C	No direct effect The secondary effect of reducing instream flow may also raise temperature in the warm season	Effect of pipeline conveyance on effluent temperature is undefined. Thus, the effect on temperature in the canal is not projected	Secondary treatment and land disposal to Dodge Flat
Effects on drinking water quality in the river and canal	Effects are specific to alternative	Improved chlorination and effluent filtration is expected to lower risk of infection. Increase in effluent volume may increase risk of chemical contamination	Sewage effluent would be removed from the river and significantly lower the risk of using the river as a treated drinking water supply	Although the river below Derby Dam would improve as a potential drinking water supply, the lower river would retain a high risk for periodic contamination, and the Truckee Canal would be significantly degraded	Secondary treatment and land disposal to Dodge Flat
Effects on water quality in Pyramid Lake	Urbanization is expected to increase the associated nonpoint source load of biologically active agents entering the lake. The impacts are undefined Decreased agriculture is expected to reduce the volume of irrigation return water and associated loads of salts, nutrients and suspended solids	At the time of conversion from the 30 mgd ESP to the Master Project the total nitrogen load could be reduced by 43 percent which could rise to a 16 percent reduction at 40 mgd. Reductions in nitrogen load are expected to cause the lake to continue to be nitrogen limited. Waste constituents not targeted for removal will increase in proportion to effluent volume	The total nitrogen load could be reduced by as much as 63 percent. The array of waste constituents associated with the JWPCP effluent would not enter the lake except for the groundwater return from Dodge Flat	The total nitrogen load could be reduced by 38 percent depending on how much is released from the canal to the lower river. A significant reduction in waste constituent loading would result.	Secondary treatment and land disposal to Dodge Flat
Effects on water quality in Lahontan Reservoir	Similar to above	The total nitrogen load could initially be decreased by 77 percent which diminishes to 45 percent at 40 mgd. The total phosphorus load could be reduced by as much as 95 percent from the present. The reservoir should be nitrogen limited	The total nutrient load would be reduced to the river base load. Reductions of 85-62 percent in total nitrogen and 97-93 percent in total phosphorus loads are expected to improve opportunities for beneficial uses impaired by excessive eutrophication	The total nitrogen load could increase over the present by 100-159 percent. There would be a significant decrease in phosphorus load from the JWPCP but phosphorus stored in the reservoir and entering with Carson River water may cause the increased nitrogen load to present excessive algal blooms to greater levels of unacceptability	Secondary treatment and land disposal to Dodge Flat
Effects on water quality downstream of Lahontan Reservoir	No significant effect expected	No significant effect expected	No significant effect expected	Depending on canal and reservoir operations there could be significant effects	Secondary treatment and land disposal to Dodge Flat

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
FISH AND WILDLIFE HABITAT					
Effects on fish habitat and fisheries between Vista and Derby Dam	Improve habitat and increase fishery potential	Abate acute and chronic toxicity Reduce algal growths Increase number of species of invertebrates Reduce DO sag in water and bottom sediments Support sport fish and a fishery	Remove JWPCP effluent from the river Reduce instream flow with potential significant impact on autumn and winter spawning fish Fish and aquatic invertebrate habitat similar in quality to that above Steamboat Creek Support sport fish and a recreational fishery	Similar to land disposal at Dodge Flat	Secondary treatment with land disposal at Dodge Flat or secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on fish habitat and fisheries between Derby Dam and Pyramid Lake	Same as above, plus Potential for a slightly lower instream flow due to urban growth	Similar to above	Similar to above, plus Potential for significantly lower average instream flows Potential incremental loss in cui-ui spawning and dispersion habitat Potential impairment of fish access to river from Pyramid Lake	Significantly reduces amount of JWPCP effluent entering the lower river Reduces algal growth Increases diversity of invertebrate species Moderate fluctuations in DO and pH Reduces organic content in bottom sediments Potential to change instream flow both beneficially and/or adversely	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on fish habitat and fisheries in Pyramid Lake	Potential to reduce inflow into lake and contribute to lowering of lake	Stabilization of eutrophication of lake Reduces total nitrogen and total phosphorus loading to lake Potential to increase load of salts and other solutes not removed by treatment process	Removes nutrient and other potential pollutants of JWPCP origin Lower average primary productivity Potential to improve DO concentrations in deep water Increase clarity of water Reduces salt load Reduces annual inflow of water by an average of 9 percent Contributes to lowering of the lake	Reduces nutrient and other potential pollutant load on the lake Maintains or lowers primary productivity in the lake Reduces salt load to the lake	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on fish habitat and fisheries in Truckee Canal	No effects identified	Reduce algal growth potential Reduce public health risk	Significantly reduces algal growth potential Significantly reduces public health risk Improves opportunity for recreational fishery	Cause acute and chronic toxic conditions for fish Cause excessive algal and other microorganism growth High risk for contamination of fish flesh Reduce species diversity	Secondary treatment with land disposal at Dodge Flat
Effects on fish habitat and fisheries in Lahontan Reservoir	No identified effect	Reduces nutrient load from JWPCP Potential to reduce algal growth Slow down eutrophication process	Significantly reduces nutrient and other pollutant load Reduce algal growth and perhaps raise DO in hypolimnion Improve aesthetics Improve fishery	Significantly increase nitrogen load which is judged to cause greater algal growth related problems Potential to cause toxic conditions near dam Adversely affect sport fish and fishing Impair aesthetics of recreational fishing	Secondary treatment and land disposal at Dodge Flat
Effects on endangered fish - cui-ui	Secondary growth effects of lowering instream flow and increasing nonpoint source pollutant load	Improves fish habitat in lower river Reduces JWPCP impact on Pyramid Lake	Significantly improves water quality in lower river Diminishes instream flow in lower river Potential to increase problem of spawning areas from lake to river Reduces quantity of river habitat Contributes to lowering of lake	Potential for catastrophic effects if JWPCP treatment fails and effluent is released from canal to lower river	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
Effects on threatened fish - Lahontan cutthroat trout	Same as above	Improves year-round habitat in Truckee River Improves spawning gravel quality Allow passage during coolwater season	Removes water quality effects of JWPCP between Vista and Pyramid Lake Reduces low Q_{10} instream flows and causes loss of flow related habitat Impairs passage from lake to above Vista	Causes toxic conditions for fish entering the canal Same as land disposal for habitat conditions from Vista to Darby Dam Potential for catastrophic event in lower river if JWPCP fails	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on wildlife	Secondary growth effects of converting wild and agricultural lands to urban and project uses	Potential loss of riparian habitat at outfall locations	Loss of 4,200 acres of native habitat Potential loss of riparian habitat along river	Potential loss of riparian habitat along river	AWT with Truckee River disposal
GROUNDWATER					
Effects on groundwater quality	No common effects	No significant effect expected	Excess irrigation will recharge groundwater, increase nitrates, leach salts from lake bed, eventually trigger poor quality return flows to Truckee River Quality degradation of Wadsworth area wells, and in wells near Fernley drain Rapid infiltration will lead to return flows to Truckee River within 10 years, returning JWPCP pollutants to river and Pyramid Lake	Percolation from canal to groundwater will degrade wells increasing nitrate levels and other constituents	AWT with Truckee River disposal
WATER SUPPLY					
Effects on water supply for M&I use	No common effects	Continuation of discharge of effluent to Truckee River and Truckee Canal, which is used as a direct water supply in Hazen, and an indirect supply from wells in Wadsworth, Fernley and Fallon	May contaminate wells used for domestic purposes in Wadsworth and near Fernley drain	Will degrade water supply for Hazen, and may degrade groundwater used for water supply in Fernley and Fallon	AWT with Truckee River disposal
PUBLIC HEALTH					
Effects on public health risks	Small risk of public exposure to pathogens from sewage treatment plant	Small risk of public exposure to pathogens from discharge to river	Risk of contact with aerosol particles from spray irrigation at Dodge Flat Risk of well contamination at Wadsworth from irrigation, rapid infiltration and Fernley drain discharge	Risk of contact with effluent in Truckee Canal, in Hazen's untreated water supply, in Lahontan Reservoir, and in lateral canals and reservoirs. Risk of well contamination near canal	AWT with Truckee River disposal
CULTURAL RESOURCES					
Effects on historic and archeological resources	No common effects	Disturbance of several sites on outfall alignment, depending on location	Disturbance of several sites on outfall alignment and loss of numerous sites at Dodge Flat. Site significance not determined	Disturbance of several sites on outfall alignment	AWT with Truckee River disposal
SOCIO-ECONOMICS					
Effects of growth on Truckee Meadows	Decreased agricultural acreage, decreased groundwater recharge, increased surface water diversions; increased demands on urban services; impaired ability to meet air quality standards; and other factors	All effects are common	All effects are common	All effects are common	No difference

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
COST					
Effect on monthly sewer service charges	Increased costs	From $2-$7 per month cost increase	From $2-$7 per month cost increase	About $2 per month cost increase	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
LAND USE					
Effect of alternatives on land use	No common effects	No significant effect expected	Change in use of 4,200 acres at disposal site, and 640 acres at rapid infiltration site, plus minor impacts along outfall pipeline	No significant effect expected, except minor impacts along outfall	AWT with Truckee River disposal
ENERGY					
Relative energy consumption	Impacts are specific to alternative	Energy intensive treatment process	Energy intensive disposal method	Lowest energy use	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal

of agricultural water uses to urban water uses, increase in the nonpoint source production of water pollutants which may enter surface or groundwaters, and greater demand for utility and social services. There are programs and regulatory processes in place that are separate from the Master Project with the responsibility and authority to mitigate these impacts of growth. The scopes and efficiencies of these programs are not the subject of this Draft EIS.

Impact Comparison of Alternatives

The resolution of issues and the mitigation of adverse impacts directly relatable to the Master Project alternatives are within the purview of the EPA, DOI, NDEP, and the Cities of Reno and Sparks. Each alternative brings with it significant problems relative to gaining implementation. The situation of Alternative L-1, as recommended for implementation in the Draft Facilities Plan compared to other alternatives, is:

- L-1 is the least costly to Reno and Sparks for construction and for operation and maintenance. It should be noted that the estimated costs do not include the costs for mitigating the significant adverse impacts.
- Although L-1 removes the direct discharge of JWPCP effluent from the river, a significant nutrient and potential pollutant load is returned to the lower Truckee River via seepage and direct turnout from the Truckee Canal. The total nitrogen load may be greater than for AWT treatment and river disposal. Among the alternatives only land disposal at Dodge Flat completely removes the discharge of JWPCP effluent from the river, and even with this alternative there may be groundwater returns to the Truckee River. Nutrient loading is a significant issue to the Paiute Indian tribe, the DOI, the EPA, and others.
- The direct discharge of effluent to the Truckee Canal can account for up to 60 cfs or about 42,000 AFY of the TCID water allotment from the Truckee-Carson River system. This action may constitute a change in point of diversion and require a technical change in the TCID water permit. Water right changes are not required to implement AWT treatment and river disposal, but water rights of about 12,000 acre-feet may have to be acquired to implement land disposal.

- Both the Truckee Canal Alternative (L-1) and alternatives to dispose of the effluent at Dodge Flat (L-6 and L-7) could significantly reduce low flows in the river between Steamboat Creek and Derby Dam. A trade-off for the reduction in flow is improved water quality in this reach of river.

- Land disposal at Dodge Flat (Alternatives L-6 and L-7) would increase the risk of water shortages to the Newlands Project. This raises water rights questions as to just which water users would be affected and to what degree during a drought if land disposal at Dodge Flat is implemented.

- Discharge to the Truckee Canal is expected to cause fish kills in the canal from ammonia, nitrite and possibly chlorine toxicity. The risk would be greatest at low dilutions. The Nevada Department of Wildlife wishes to retain the fishery potential of the canal. Neither of the other disposal alternatives would cause acutely toxic conditions in surface waters.

- The Town of Hazen draws a part of its untreated domestic water supply from the Truckee Canal. The direct discharge of JWPCP effluent to the canal raises the level of risk for human infection or contamination from drinking untreated canal water. A similar but lower risk occurs with river disposal near Vista. Land disposal at Dodge Flat on the other hand would significantly reduce the risk to Hazen residents as compared to other disposal options.

- Domestic water supply wells drawing from the shallow aquifer along the Truckee Canal are affected by water quality in the canal as well as percolating irrigation water. Relatively undiluted wastewater flowing in the canal and seeping into the groundwater may alter groundwater quality and increase the risk of chemical contamination of the domestic wells. Increased levels of nitrate would be expected and contamination from refractive organic chemicals is possible.

- Alternative L-1 would greatly increase the amount of algal-stimulating nutrients entering Lahontan Reservoir as compared to other alternatives. The increased load of nitrogen and other nutrients is expected to exacerbate water quality problems in the reservoir. Disposal to the Truckee River would significantly reduce the nutrient load while land disposal would remove the total load originating from the JWPCP.

- Disposal to the Truckee Canal offers significant protection to Pyramid Lake by reducing the JWPCP waste load reaching the lake without reducing water flows to the lake, if the problems associated with the potential to turn canal water and JWPCP effluent into the lower river are mitigated. Although water quality entering the lake with land disposal would be advantageous, the potential to diminish the amount of water entering Pyramid Lake may offset the advantage.

- The canal disposal alternative has the potential to affect the cui-ui by returning wastewater to the lower river. If this were done during treatment plant failure and at the time cui-ui are in the lower river, fish in the lower river could be harmed. The risk of catastrophic events seems low and is mitigatable. The lowering of river flow and potential effect on cui-ui spawning migrations and dispersal opportunities associated with the land disposal option are judged to cause a greater risk. AWT treatment with river disposal does not adversely affect the cui-ui relative to present conditions.

- If mitigatable adverse effects are corrected, opportunities for the recovery of Lahontan cutthroat trout and rainbow trout habitat in Truckee River seem to be improved most by Alternative L-1, because water and river sediment conditions would be significantly improved without impairing instream flow during critical seasons. Toxic conditions in the canal may cause the death of trout entering the canal.

Each of the three principal Master Project alternatives has significant advantages and disadvantages. The disposal of effluent to the Truckee Canal as recommended in the Facilities Plan may require the addition of physical solutions to mitigate significant adverse impacts. Several institutional arrangements would also be required, e.g., contracts between Reno-Sparks and TCID, a change in point of diversion of 60 cfs of water, water rights protections between Vista and Derby Dam, protection of the Hazen water supply, protection of groundwaters recharged by the canal, and changes in state water quality standards that protect beneficial uses in the canal and Lahontan Reservoir.

The implementation of land disposal to Dodge Flat requires the solution of complex water rights and river flow problems. Also, the manner in which the agricultural business is to operate is presently undefined.

Conclusions

It is concluded in this Draft EIS that the potential for significant adverse impacts exists with all JWPCP alternatives as presently proposed in the cities' Facilities Plan. Public release and review of this EIS should further focus attention on the identified issues, and lead to further planning work to formalize acceptable solutions to the identified needs and problems.

The purpose of this Environmental Impact Statement is to publicly present all of the issues surrounding the project and its objectives, so they can be resolved as openly and satisfactorily as possible. In keeping with this open policy, the Environmental Impact Statement has been developed as part of a decision process to select the most desirable wastewater management alternative and to determine the appropriate treatment capacity in accordance with local, state, and federal regulations and objectives. Comments received on the DEIS, both at the public hearing and by letter, will be very useful to the selection of the most environmentally sound wastewater treatment and disposal project.

Following the comment period and selection of a project eligible for federal funding under section 201 of PL 92-500 as amended, a Final EIS will be prepared and distributed by the EPA.

The distribution list for this DEIS is included at the end of the report. Written comments on the DEIS should be forwarded to:

Mr. Thomas Severino, Project Officer
U. S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, CA 94105

TABLE OF CONTENTS

Page

CHAPTER 1 - INTRODUCTION 1

- Background and History of the Project 1
  - Early Start Wastewater Treatment Program (the No-Project Alternative) 3
  - Early Start Sludge Program 3
  - Master Project 4
- Problem Description/Issues 4
- Project Objectives 4
- Purpose and Necessity of This EIS 5
- Laws, Rules and Policies Affecting the Master Project 6
  - Federal Laws, Policies and Regulations 6
  - State Laws, Regulations, and Policies 9
  - Local Laws, Rules and Regulations 10
- Agencies Involved and Public Participation 10
- Study Area Characteristics 11
  - Regional Study Area Location 11
  - Climate 11
  - Land Resources 11
  - Water Resources 14
  - Biological Resources 18
  - Air Quality 20

CHAPTER 2 - EXISTING WASTEWATER CONVEYANCE, TREATMENT AND DISPOSAL IN THE TRUCKEE MEADOWS 23

- Existing NPDES Permit 23
- Wastewater Treatment in the Truckee Meadows 25
  - Individual Disposal Systems (Septic Tanks) 25
  - Package Wastewater Treatment Plants 25
  - Reno-Sparks JWPCP 30
- Current Effluent Quality and Operational Limitations 33
- Combined Sewer Separation 35

CHAPTER 3 - ALTERNATIVES FOR WASTEWATER TREATMENT AND DISPOSAL 37

- Introduction 37
  - Planning Constraints 37
  - Master Project Design Criteria 38
- Alternative Concepts Initially Studied 38
  - Effluent Discharge Limitations 38
  - Secondary Treatment Concepts Common to All Alternatives 39
  - Advanced Wastewater Treatment Alternatives For Truckee River Discharge 39
  - Land Application Alternatives 41

Page

Feasibility and Economic Screening of Alternatives 41
Description of Master Project Alternatives Selected for Detailed Analysis 41
  Advanced Wastewater Treatment Alternatives - Truckee River Discharge 41
  Land Application Alternatives 44
  Truckee Canal Discharge 44
  Effluent Discharge Limitations Used in the Detailed Screening Analysis 44
  Alternative T-5 - Fluidized Bed Nitrification/Denitrification - Truckee River Discharge 44
  Alternative T-6a - Modified PhoStrip Nitrification/Denitrification - Truckee River Discharge 47
  Alternative T-9 - Selective Ion Exchange - Truckee River Discharge 48
  Alternative T-12 - Trickling Filter Nitrification/Denitrification 51
  Alternative T-14a - Modified PhoStrip Nitrification/Denitrification with Supplemental Denitrification for Polishing - Truckee River Discharge 53
  Alternative T-15 - Trickling Filter Nitrification/Fluidized Bed Denitrification 55
  Alternative L-1 - Truckee Canal Diversions, Land Application 57
  Alternative L-6 - Dodge Flat Irrigation with Winter Rapid Infiltration 57
  Alternative L-7 - Dodge Flat Irrigation/Fernley Drain Option 62
  Outfall Facilities 62
Sludge Handling and Disposal 64
Summary of Alternative Wastewater Treatment Process Costs 69
Actions Proposed by Reno and Sparks 69
  Allocation of Recommended Project Costs 72
  Schedule for Implementation of the Recommended Project 73

CHAPTER 4 - AFFECTED ENVIRONMENT 75

Introduction 75
Surface Hydrology - Truckee River Basin 75
  Institutional Influences 80
Hydrologic Modeling 83
  Summary of Changes in Truckee River Flows 112
Surface Water Quality 113
  Introduction 113
  PEL Conclusions 114
  Methodology 124
  Lake Tahoe to Stateline 127

Page

Stateline to Steamboat Creek 128
Steamboat Creek to Vista 144
Vista to Derby Dam 163
Derby Dam to Pyramid Lake 166
Pyramid Lake 173
Truckee Canal 189
Lahontan Reservoir 192
Below Lahontan Reservoir 201
Fish and Wildlife 203
Aquatic Habitat and Fish in the Truckee River 203
Threatened and Endangered Fish and Wildlife Species 210
Terrestrial Habitat and Wildlife 216
Groundwater Resources 222
Truckee Meadows 222
Wadsworth Area 231
Fallon Area 231
Dodge Flat Area 232
Water Supply 232
Recreational Fishing and Hunting 241
Truckee River 241
Pyramid Lake 244
Lahontan Reservoir 245
Stillwater Wildlife Management Area 245
Fernley Wildlife Management Area 245
Cultural Resources 246
Historic and Prehistoric Sites 246
Evaluation Considerations 248
Land Use 249
Socio-Economics 250
Air Quality 250
Introduction 250
Relationship of Reno-Sparks Sewage Treatment Plant Expansion to Air Quality 252
Air Quality Monitoring 252
Trends in Pollutant Levels 252
Pollutant Sources 254
Effects of the ESP on Air Quality 254
Dodge Flat Wastewater Reuse Area 254
Project Location 254
Climate 257
Land Resources 257
Water Resources 260
Cultural Resources 260
Land Use and Ownership 261
Biological Resources 261
Spanish Springs Valley - JWPCP Sludge Handling and Disposal Project 264
Project Location 264
Climate 264
Land Resources 267
Water Resources 267

Page

Biological Resources 268
Cultural Resources 269
Land Use, Ownership and Zoning 273

CHAPTER 5 - ENVIRONMENTAL CONSEQUENCES OF THE MASTER PROJECT ALTERNATIVES 277

INTRODUCTION 277

SHORT-TERM CONSTRUCTION IMPACTS OF THE MASTER PROJECT 280

OPERATIONS IMPACTS: LONG-TERM DIRECT AND SECONDARY EFFECTS OF WASTEWATER TREATMENT AND DISPOSAL 287

Impacts Common to All Alternatives 288
Common Advantages 287
Common Disadvantages 292
Land Use 296
Socio-Economic Impacts 303
Institutional Constraints 307
Reliability of Treatment Processes and Options During Emergencies 309
Package Plants 313
Air Quality 315
Mitigation of Common Impacts 318
Impacts of Effluent Disposal to the Truckee River (Alternatives T-5, 6a, 9, 12, 14a, 15) 320
Surface Water Hydrology 322
Water Quality 322
Truckee River 323
Pyramid Lake 344
Truckee Canal 349
Lahontan Reservoir 349
Fish and Wildlife 354
Groundwater 358
Water Supply 358
Potential Risks to Public Health 358
Cultural Resources 361
Institutional Considerations 361
Energy 361
Mitigation of Truckee River Disposal Impacts 362
Impacts of Land Disposal at Dodge Flat (Alternatives L-6 and L-7) 364
Surface Hydrology 365
Water Quality 368
Truckee River 368
Truckee Canal 373
Institutional Considerations 377
Fish and Wildlife 377
Groundwater 384
Water Supply 385
Risk to Public Health 385

Page

Cultural Resources 387
Land Use 387
Institutional Concerns 389
Energy 389
Aesthetics 390
Mitigation of Dodge Flat Land Disposal Impacts 390
Impacts of Truckee Canal Disposal (Alternative L-1) 394
Surface Hydrology 394
Water Quality 396
Truckee River 398
Institutional Constraints 409
Fish and Wildlife 410
Groundwater 413
Public Health 413
Cultural Resources 418
Land Use 418
Institutional Concerns 419
Energy 420
Mitigation of Truckee Canal Disposal Impacts 420
Impacts of JWPCP Sludge Handling and Disposal 423
Sludge Pipeline Impacts 423
Spanish Springs Sludge Disposal Site Impacts 425

IMPACTS OF NO-ACTION (ESP CONDITIONS) 432

Comparison of Significant Environmental and Cost Considerations Relative to the Selection and Implementation of the Reno-Sparks JWPCP Master Project 435

CHAPTER 6 - ISSUES UNRESOLVABLE BY THE MASTER PROJECT 447

CHAPTER 7 - COORDINATION 449

Comments Received Through Workshops and Meetings 449
Public Workshops - Held on March 20, 21, and 22, 1979 in Reno, Wadsworth, and Fallon, Respectively 449
Public Workshops - April 24, 25, 26 held in Reno, Wadsworth, and Fallon, Respectively 451
Comments Received Through Distribution of the Preliminary Draft EIS 453

DISTRIBUTION LIST 455

BIBLIOGRAPHY 465

Page

APPENDICES* 473

- Appendix A - Regional Economy, Future Population Growth and Housing
- Appendix B - Air Quality
- Appendix C - Water Law and Water Rights
- Appendix D - Cultural Resources Survey for the Master Project
- Appendix E - Surface Water Hydrology
- Appendix F - Surface Water Quality
- Appendix G - Hydrologic Modeling
- Appendix H - Limnology of Pyramid Lake and Lahontan Reservoir
- Appendix I - Endangered and Threatened Species
- Appendix J - Fish and Wildlife Resources
- Appendix K - Background Agreements and Permits

*There are 11 appendices to the EIS, covering the topics listed above. The appendices are bound in three volumes containing Appendices A-D, E-G, and H-J, respectively. Interested readers may order one each of any or all of the volumes that are of interest to them. These should be ordered from:

Mr. Thomas Severino, Project Officer
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LIST OF TABLES

Table Number	Title	Page
2-1	NPDES Permit No. NV0020150 (originally issued April 1977) Limitations	24
2-2	Existing Package Plant Wastewater Facilities in the Truckee Meadows Area	28
2-3	Proposed Package Plant Wastewater Treatment Facilities for the Truckee Meadows Area	31
2-4	Reno-Sparks JWPCP Wastewater Characteristics	34
3-1	Effluent Discharge Limitations Used in the Initial Screening Analysis	40
3-2	Initial Screening Costs of Advanced Waste Treatment Alternatives	42
3-3	Initial Screening Costs of Land Application Alternatives	43
3-4	Effluent Discharge Limitations Used in the Detailed Screening Analysis	45
3-5	Summary of Costs Used in Detailed Screening Analysis (including sludge handling)	70
4-1	Average Monthly Diversions into Several Ditches Within the Truckee Meadows	82
4-2	Comparison of Calculated Relative Changes in Mean Annual Truckee River Flows in Response to JWPCP Effluent Disposal Options	92
4-3	Comparison of Calculated Relative Changes in Mean Annual Truckee River Flows in Response to Urbanization in Truckee Meadows	93
4-4	Comparison of Calculated Relative Changes in 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations Due to Changes in JWPCP Effluent Disposal Options	95
4-5	Comparison of Relative Changes in Calculated 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations Due to Incremental Truckee Meadows Growth from 30 mgd to 40 mgd Population Equivalent. Percent of Base Case	96

LIST OF TABLES, continued

Table Number	Title	Page
4-6	Summary of Calculated Relative Changes in 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations Due to JWPCP Disposal Options	97
4-7	Summary of Calculated Changes in 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations Due to Truckee Meadows Growth from 30-40 mgd Equivalent Population	98
4-8	Comparison of Calculated Relative Changes in Drought Periods as a Function of JWPCP Effluent Disposal Options	102
4-9	Comparison of Calculated Relative Changes in M&I Deficits in Drought Periods as a Function of Urbanization of Truckee Meadows	103
4-10	Comparison of Calculated Relative Changes in Computed Newlands Project Shortages (Truckee Division and Carson Division)	106
4-11	1-in-10-Year Flow By-Passed to Below Derby Dam as a Percent of the Total Flow at Derby Dam	107
4-12	1-in-10-Year Flow Below Derby Dam as a Percent of Pyramid Lake Inflow	109
4-13	Historical 7-Day Low Q_{10} Flows Below Derby Dam	111
4-14	Historical 30-Day Low Q_{10} Flows Below Derby Dam	111
4-15	Water Quality Standards, Truckee River, Nevada	116-19
4-16	Water Quality Studies of the Truckee River	120
4-17	Truckee River Water Quality Conditions Annual Average - October 1977 to August 1978	121
4-18	Estimated Average Urban Pollutant Loads: Reno-Sparks Area	141
4-19	Estimated Average Urban Pollutant Loads for Reno-Sparks Area (Year 2000)	142

LIST OF TABLES, continued

Table Number	Title	Page
4-20	Estimated Pollutant Loads for Reno-Sparks Area (Year 2000)	145
4-21	Comparison of Truckee River Water Quality for Lockwood Bridge and Environmental Protection Agency's Recommended Standards	155
4-22	Projected Average Annual Pollutant Loads in the Truckee River Below Steamboat Creek Following Completion of the Early Start Project	162
4-23	Water Quality Conditions at Clark	164
4-24	Water Quality of Return Flows to the Truckee River Below Derby Dam	168
4-25	Historical Wastewater Constituent Loads in the Truckee River below Derby Dam	171
4-26	Summary of Precipitation and Air Temperature at Truckee, California, and Hydrologic and Water Quality Conditions for Truckee River Near Nixon, Nevada: Water Year 1969	183
4-27	Truckee Canal Water Quality	190
4-28	Summary of Available Algal Nutrient Data for Lahontan Reservoir	194
4-29	Background Nutrient Analysis of Water Content at Two Stations in Lahontan Reservoir During Four Sampling Dates	197
4-30	Relative Abundance/Biomass of Fishes Sampled From Verdi Power Diversion to Pyramid Lake	209
4-31	Fishes of the Lower Truckee River System From Verdi to Pyramid Lake	211-12
4-32	Drinking Water Quality Standards	225
4-33	Truckee Meadows Groundwater Basin Water Balance - Working Estimates	230
4-34	Historical Water Use and Number of Customers in the SPPCo Water System	237

LIST OF TABLES, continued

Table Number	Title	Page
4-35	Water Use in the Truckee Meadows and California	239
4-36	Fishing Use Data	242
4-37	Ambient Air Quality Standards	253
4-38	1977 Emissions Inventory - Truckee Meadows Air Basin	255
4-39	Selected Characteristics of Dodge Flat Sampling Units as Determined by Preliminary Surveys	262-63
4-40	Selected Characteristics of the Cultural Resources Located During a Preliminary Surface Reconnaissance of the Reno-Sparks Sewage Effluent Sludge Disposal Area, Spanish Springs Canyon, Washoe County, Nevada	271
5-1	Potential Short-term Impacts of Master Project Alternatives	281-84
5-2	Estimated Acres of Additional Urban Land Uses Supported by JWPCP Capacity Increases	301
5-3	Chronology of Legal Action Affecting the Truckee River	310-12
5-4	Existing and Projected Annual Average Total Nitrogen Loading to Surface Waters	325
5-5	Existing and Projected Annual Average Total Phosphate Loading to Surface Waters	326
5-6	Projected Average Annual Pollutant Loading at the Confluence of the Truckee River and the JWPCP Outfall, for River Discharge of 40 mgd	327
5-7	Estimated Average Monthly Concentrations of Various Pollutants at the JWPCP Effluent/Truckee River Confluence at Mean Monthly Flows, 40 mgd River Disposal	328

LIST OF TABLES, continued

Table Number		Page
5-8	Estimated Nitrite, Nitrate and Ammonia Concentrations Below the JWPCP Outfall During Low Q_{10} Flow for River Disposal of 40 mgd	330
5-9	Estimated Truckee River Temperatures Below the JWPCP Outfall	333
5-10	Comparison of Present and Proposed Oxygen Depleting, Nutrient and Solids Loading from the Reno-Sparks JWPCP to the Truckee River	335
5-11	Computed Average Annual Pollutant Load By-Passed at Derby Dam to the Lower Truckee River, Excluding Spills and Seepage from the Truckee Canal	337
5-12	Computed Accretions to the Truckee River in the Derby Dam-Pyramid Lake Reach	339
5-13	Estimated Pollutant Loads at Nixon Including Accretions Estimated from PEL-Measured Quality Changes Between Derby Dam and Nixon	340
5-14	Estimated Truckee River Pollutant Load Near Nixon. Computed as the Summation of the Pollutant Loads Retained in the River at Derby and Accretions Calculated from Truckee Canal Spills and Seepage	341
5-15	Estimated Total Soluble Inorganic Nitrogen to Orthophosphate Ratios Near Nixon for the Various Disposal Options, 40 mgd Discharge	343
5-16	Estimated Average Annual Concentration of Various Constituents in the Lower Truckee River	345
5-17	Computed Average Annual Pollutant Load at the Terminus of the Truckee Canal for Each Alternative	351
5-18	Average Computed Annual Pollutant Load at the Head of the Truckee Canal	352

LIST OF TABLES, continued

Table Number	Title	Page
5-19	Average Loads of Selected Potential Pollutants Discharged into Lahontan Reservoir	353
5-20	Estimated Concentration of Various Pollutants at the Confluence of the Truckee River and the JWPCP Effluent for a Mean Monthly Flow	370
5-21	Estimated Concentration of Various Pollutants in the Truckee River at Vista for Calculated Mean Monthly Flows	372
5-22	Characteristics of the JWPCP Effluent under Truckee Canal Disposal	401
5-23	Comparison of Calculated Average Monthly Dilutions and Resultant Quality at the Head of the Truckee Canal	402
5-24	Computed Unionized Ammonia Concentrations at the Point of Discharge to the Truckee Canal under the Canal Disposal Alternative	405
5-25	Annual Contributions of Truckee Canal to Lahontan Reservoir Outflow	415
5-26	Annual Addition of Constituents to the Soil	430
5-27	Summary Comparison of the Environmental Consequences of Alternative Reno-Sparks JWPCP Master Projects	436-40

LIST OF FIGURES

Figure Number		
1-1	Regional Area	12
2-1	Sewer Service Area Boundaries	26
2-2	Existing and Proposed Package Plants in the Truckee Meadows	29
3-1	Alternative T-5: Treatment Schematic for Fluidized Bed Nitrification/Denitrification	46

LIST OF FIGURES, continued

Figure Number	Title	Page
3-2	Alternative T-6: Treatment Schematic for Modified Phostrip Nitrification/Denitrification	49
3-3	Alternative T-9: Treatment Schematic for Selective Ion Exchange	50
3-4	Alternative T-12: Treatment Schematic for Trickling Filter Nitrification/Denitrification	52
3-5	Alternative T-14a: Treatment Schematic for Modified Phostrip Nitrification/Denitrification with Supplemental Denitrification for Polishing	54
3-6	Alternative T-15: Treatment Schematic for Trickling Filter Nitrification/Fluidized Bed Denitrification	56
3-7	Alternative L-1: Treatment Schematic for Truckee Canal Diversion	58
3-8	Alternatives L-6 and L-7: Treatment Schematic for Dodge Flat Irrigation	60
3-9	Elements of the Proposed Dodge Flat Irrigation System	61
3-10	Proposed Outfall Route for Land Disposal Alternatives	65-7
4-1	Truckee River	76
4-2	A Portion of the Historical Hydrograph of the Truckee River at Farad	79
4-3	Major Irrigation Ditches Within the Truckee Meadows	81
4-4	Diagram of Scenarios: JWPCP Hydrologic Impact Analysis	89
4-5	Water Quality Monitoring and Control Points on the Truckee River System	115
4-6	Total Nitrogen and Total Phosphorus Measured in the Truckee River in 1977-1978	133

LIST OF FIGURES, Continued

Figure Number	Title	Page
4-7	Ammonia-N and Nitrate-N Measured in the Truckee River in 1977-1978	134
4-8	Periphyton Measured in the Truckee River, 1977-1978	135
4-9	Total Phosphorus and Orthophosphate in the Truckee River in 1977-1978	136
4-10	Total Dissolved Solids Measured in the Truckee River, 1977-1978	137
4-11	Temperature Diurnal Range Measured on the Truckee River, 1977-1978	139
4-12	Ammonia Loading to the Truckee River in the Stateline to Vista Reach	147
4-13	Nitrate Loading to the Truckee River in the Stateline to Vista Reach	148
4-14	Nitrite Loading to the Truckee River in the Stateline to Vista Reach	149
4-15	Total N Loading to the Truckee River in the Stateline to Vista Reach	150
4-16	Total P Loading to the Truckee River in the Stateline to Vista Reach	151
4-17	Phosphate Loading to the Truckee River in the Stateline to Vista Reach	152
4-18	Total Dissolved Solids Loading to the Truckee River in the Stateline to Vista Reach	153
4-19	Chloride Loading to the Truckee River in the Stateline to Vista Reach	154
4-20	Dissolved Oxygen Diurnal Range Measured in the Truckee River in 1977-1978	157
4-21	BODs and TOC in the Truckee River in 1977-1978	158
4-22	Unionized Ammonia-N and Nitrite-N Measured in the Truckee River in 1977-1978	159

LIST OF FIGURES, continued

Figure Number	Title	Page
4-23	Water Quality Sampling Locations of Return Flows from the Fernley Benchlands	169
4-24	Mean Limnetic Chlorophyll (A) Concentrations and Total Solar Radiation, Pyramid Lake, Nevada	178
4-25	Mean Monthly Limnetic Gross Photosynthesis, Pyramid Lake, Nevada	178
4-26	Water Surface Fluctuations of Pyramid Lake	180
4-27	Stream Flow, Suspended-Sediment Load, and Solute Load Carried by Truckee River Near Nixon During Water Year 1969	183
4-28	Variations of Water Quality Parameters in Lahontan Reservoir at EPA Station 320204	195
4-29	Newlands Project-Nevada-California	202
4-30	Approximate Water Table and Locations of Groundwater Discharge Areas, Truckee Meadows Area	223
4-31	Better Quality Groundwater Area	227
4-32	Water Service Area Boundaries	233
4-33	Surface Water and Groundwater Pumpage for the SPPCo System	235
4-34	SPPCo Customers and Water Use, 1940 to 1978	236
4-35	Truckee Meadows Air Basin	251
4-36	Relative Contribution of Pollutant Sources (1977)	256
4-37	The Fault Zones of the Dodge Flat Wastewater Disposal Site.	259
4-38	Recommended Project Sludge Disposal Site and Force Main Route	265
4-39	Recommended Project Sludge Disposal Site Plan	266

LIST OF FIGURES, continued

Figure Number	Title	Page
4-40	Map showing the location of the cultural resources disclosed during a preliminary surface reconnaissance of the proposed sludge disposal area, Spanish Springs Canyon, Washoe County, Nevada	270
4-41	Spanish Springs Valley (District 12) Land Use Plan	275
5-1	Approximate Urbanized Area of Truckee Meadows, 1979	298
5-2	Estimated Land Use Changes as Illustrated by Expansion of Urban Limits	299
5-3	Average Monthly Flow Duration Curves for Vista at the 406 Scenario Operating Criteria	378
5-4	Average Monthly Flow Duration Curves for Vista at the 288 Scenario Operating Criteria	379
5-5	Average Monthly Flow Duration Curves for Nixon (Pyramid Lake Inlet) at the 406 Scenario Operating Criteria	381
5-6	Average Monthly Flow Duration Curves for Nixon (Pyramid Lake Inlet) at the 288 Scenario Operating Criteria	382
5-7	General Locations of Wells along Truckee Canal	414

LIST OF ACRONYMS

AF - Acre-foot
AGP - Algal Growth Potential
AQIP - Air Quality Implementation Plan
AWT - Advanced Wastewater Treatment

BBER - University of Nevada, Bureau of Business and Economic Research
BEA - U. S. Bureau of Economic Analysis
BIA - U. S. Bureau of Indian Affairs
BLM - U. S. Bureau of Land Management
BOD - Biochemical Oxygen Demand
B.P. - Before Present

c/f - catch per unit of effort
CCFRU - Colorado Cooperative Fisheries Research Unit
CDWR - California Department of Water Resources
CEQ - U. S. Council on Environmental Quality
cfs - cubic feet per second
cm - centimeter
CO - carbon monoxide
CPI - Consumer Price Index
CRBCOG - Carson River Basin Council of Governments

DEISM - Demographic and Economic Impact Simulation Model
DO - Dissolved Oxygen
DOI - U. S. Department of the Interior
DRI - University of Nevada, Desert Research Institute
DWP - Nevada Division of Water Planning
DWR - Nevada Division of Water Resources

EIA - Environmental Impact Assessment
EIS - Environmental Impact Statement
EPA - U. S. Environmental Protection Agency
EPS - Nevada Environmental Protection Services, now called NDEP
ESP - Early Start Program
ESSP - Early Start Sludge Program
ESR - Nevada Employment Security Research

FHA - Federal Highway Administration
FV&O - Finding of Violation and Order
FIRE - Finance, Insurance and Real Estate

gpcd - gallons per capita per day
gpd - gallons per day
gpm - gallons per minute

ha - hectares
HC - Hydrocarbons

I&I - Inflow and Infiltration
I/M - Inspection and Maintenance

JWPCP - Joint Water Pollution Control Plant

km - kilometers

l - liter
LQ - Location Quotient

m - meters
M&I - Municipal and Industrial
mg - milligrams
mg/l - milligrams per liter
MGD - million gallons per day
MPN - most probable number

N - Nitrogen
NAAQS - National Ambient Air Quality Standards
NDEP - Nevada Division of Environmental Protection
NEIC - National Enforcement Investigation Center
NEPA - National Environmental Policy Act
Nevada CNR - Nevada Department of Conservation and Natural Resources
NDW - Nevada Department of Wildlife
NH_3 - Ammonia
NO_2 - Nitrite
NO_3 - Nitrate
NPDES - National Pollutant Discharge Elimination System
NRS - Nevada Revised Statutes

O&M - Operation and Maintenance
OBERS - Office of Business Economics and USDA Economic Research Service (presently BEA)
O_3 - Ozone

P - Phosphorus
PEL - Pacific Environmental Laboratories
PHS - U. S. Public Health Service
PLITE - Pyramid Lake Indian Tribal Enterprise
ppm - parts per million

RPC - Regional Planning Commission

Secretary- Secretary of the Interior
SCS - U. S. Soil Conservation Service
SIP - State Implementation Plan
SL - Standard Length
SMSA - Standard Metropolitan Statistical Area
SPC - Nevada State Planning Coordinator
SPPCo - Sierra Pacific Power Company
SS - Suspended Solids

TCID - Truckee-Carson Irrigation District
TCU - Transportation/Communication/Utilities
TDS - Total Dissolved Solids
THC - Total hydrocarbons
TKN - total Kjeldahl nitrogen
TL - Total Length
TSD - Tahoe Sanitation District
TSP - Total Suspended particulates
TTSA - Tahoe-Truckee Sanitation Agency

UNR - University of Nevada at Reno
USBR - U. S. Bureau of Reclamation (now WPRS)
USDA - U. S. Department of Agriculture
USFS - U. S. Forest Service
USFWS - U. S. Fish and Wildlife Service
USGS - U. S. Geological Survey

VMT - Vehicle miles traveled

WCDHD - Washoe County District Health Department
WCOG - Washoe Council of Governments
WCWCD - Washoe County Water Conservation District
WMA - Wildlife Management Area
WPRS - Water & Power Resources Service (formerly USBR)

Chapter 1

INTRODUCTION

Background and History of the Project

Sewage treatment for the Cities of Reno and Sparks is provided by the Reno-Sparks Joint Water Pollution Control Plant (JWPCP). The JWPCP, located on the south bank of the Truckee River east of Steamboat Creek, discharges secondary treated effluent to the Truckee River via Steamboat Creek. The Reno-Sparks JWPCP was completed in 1967 with a design capacity of 20 million gallons per day (mgd). The cost of the plant was divided equally between the Cities of Reno and Sparks, providing each with one-half of the plant's capacity.

In 1972, with the JWPCP nearing design capacity (during peak summer months, average monthly wastewater flows entering the JWPCP were about 18 mgd [Kennedy/Jenks Engineers, 1980]), the City of Reno recognized the need for additional treatment capacity to accommodate future growth. In 1972, the City of Reno was advised by the Nevada Bureau of Environmental Health (now called the Nevada Division of Environmental Protection [NDEP]) that an expansion project would have to include phosphorus removal facilities to comply with receiving water quality standards. Phosphorus standards were included in the Water Pollution Control regulations for the Truckee River issued by the Nevada Bureau of Health on July 1, 1967, after the JWPCP began operation. The JWPCP was not designed to remove phosphorus or other nutrients from the wastewater and thus was not able to meet the phosphorus limitation.

In 1974, Kennedy Engineers (now Kennedy/Jenks Engineers), under contract with the City of Reno, began preparation of a facilities plan for the expansion and upgrading of the JWPCP and the Draft Facilities Plan was completed in August 1975. The report recommended a capacity expansion to 40 mgd and the utilization of the PhoStrip process for phosphorus removal. The recommended project was planned to meet effluent quality limitations outlined in the National Pollutant Discharge Elimination System (NPDES) permit issued by the Environmental Protection Agency (EPA) on January 10, 1975.

In late 1975, EPA began preparation of an Environmental Impact Statement (EIS) on the 1975 Draft Facilities Plan. During the course of the EIS work, several water quality studies suggested the need for additional and more stringent effluent quality limitations than were specified in the 1975 NPDES permit to ensure protection of the designated beneficial uses of the Truckee River, including the endangered and threatened fish. It became apparent that the expansion and upgrading of the JWPCP would require considerably more time than the original schedule allowed in order to address these water quality concerns. At the same time, however, flows to the JWPCP were reaching design capacity as a result of the area's rapid growth and the need for an expansion of the JWPCP was becoming critical. It became apparent that the expansion and upgrading of the JWPCP should be phased or segmented in order to provide the needed treatment capacity and improve water quality, yet at the same time provide sufficient time to adequately address all the water quality concerns related to the project.

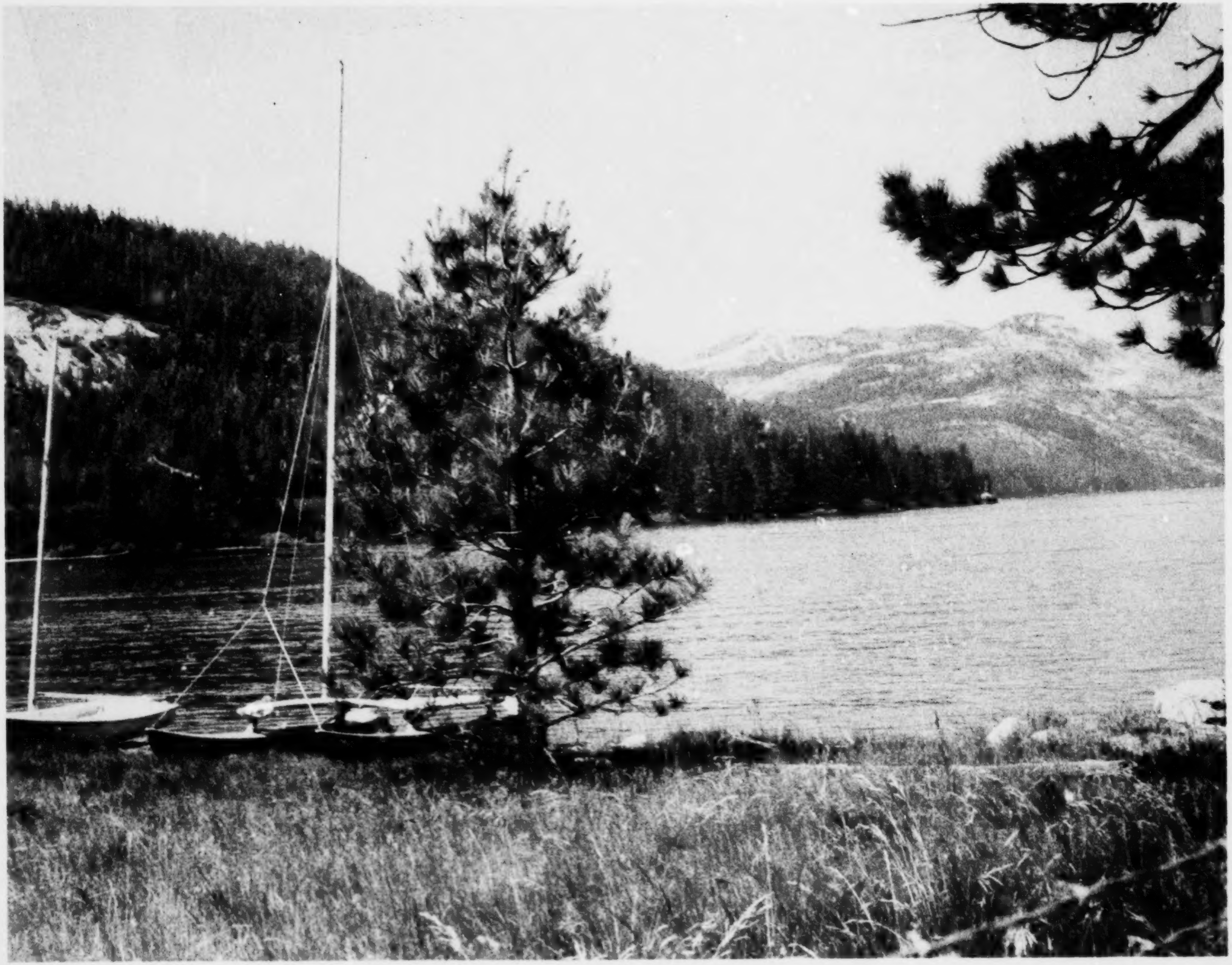
In 1976, the City of Reno and EPA decided the project should be segmented into an Early Start Project (ESP) of 30 mgd capacity, and the Master Project which will deal with required treatment levels, ultimate capacity needs, effluent disposal and sludge handling and disposal. In October 1976, EPA authorized the preparation of a Facilities Plan and environmental assessment (EA) for an ESP. On June 7, 1978, EPA issued a Negative Declaration on the construction of the ESP. Construction of the ESP began in October 1978, and is projected to begin operation in fall 1980. It should be noted that sludge handling and disposal was not included in the ESP, because the sludge disposal project recommended in the 1975 Draft Facilities Plan was environmentally controversial.

On December 7, 1976, the Department of Interior (DOI) expressed their concern with regard to the effect of Truckee River water quality on the endangered cui-ui and threatened Lahontan cutthroat trout. The following day the City of Reno proposed to expand the JWPCP and to do a detailed Truckee River water quality study to ascertain the necessary level of treatment.

In January 1977, EPA issued a Draft EIS on the 1975 Draft Facilities Plan. In April 1977, the Nevada Environmental Protection Service (EPS), now called NDEP, issued a revised NPDES permit raising the effluent quality standards required for JWPCP effluent discharged to the Truckee River.

In September 1977, Pacific Environmental Laboratory (PEL), a division of Kennedy/Jenks Engineers, began a comprehensive Truckee River water quality study. The primary purposes of this study were to: 1) evaluate the effects of the JWPCP on the water quality and aquatic organisms of

Reno.



Donner Lake.

the Truckee River and, to the extent possible, Pyramid Lake and Lahontan Reservoir; and 2) determine the most suitable level of treatment for the JWPCP expansion. This report, completed in May 1979, was to be used as a basis for determining the necessary level of treatment for the JWPCP expansion.

Due to the extended schedule for completion of the Master Project Facilities Plan, the need for a long-term solution for sludge disposal has also become critical. The practices of stockpiling sludge and hauling liquid sludge to Mustang and Lockwood landfills have been prohibited by the NDEP. The currently operating interim program of injecting liquid sludge into the soils of city-owned land adjacent to the JWPCP may not be capable of meeting water quality standards during winter months or over the period remaining until the Master Project can be constructed. It became desirable, therefore, to develop an Early Start Sludge Program (ESSP), also independent of the Master Project. The ESSP has been proposed to expedite the implementation of a long-term sludge disposal project and reduce potential risks to water quality and public health while still meeting NEPA and facilities plan review requirements. Although design of this program has not yet been approved, it is hoped that an ESSP will prevent further delays of the construction of sludge disposal facilities. Major features of each project segment are described below.

Early Start Wastewater Treatment Program (the No-Project Alternative)

The ESP consists of those elements common to all viable Master Project alternatives, i.e., expansion of treatment capacity to 30 mgd and phosphorus removal and dechlorination facilities. The effluent from the plant will continue to be discharged to Steamboat Creek at a location approximately 200 yards upstream from its confluence with the Truckee River. The ultimate discharge point will be determined in the Master Project. Construction of the ESP began in October 1978 and is scheduled for completion in fall 1980.

Early Start Sludge Program

The ESSP expands sludge disposal capacity from 20-40 mgd. Sludge treatment and digestion facilities are not affected by this project. Sludge treatment capacity was expanded from 20-30 mgd under the ESP and will be expanded from 30-40 under the Master Project. Operation of the ESSP is projected to begin in February 1982, providing a Negative Declaration is issued by the EPA for the project.

Master Project

In October 1978, Kennedy Engineers began preparation of a new Facilities Plan for the JWPCP based on the April 1977 NPDES permit and other criteria. A Draft Master Project Facilities Plan was completed in April 1980. Operation of the expanded JWPCP is projected to begin in July 1983.

Problem Description/Issues

Prior to and during the course of preparing this EIS a number of key issues were identified that warrant discussion and, if possible, resolution. The issues identified below are described in detail and evaluated in Chapter 5, THE ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES. Those issues that remain generally unresolved will be identified. The generic issues of particular importance to this wastewater treatment and disposal project are:

- The impacts on fish and other aquatic organisms, instream and offstream beneficial uses of the Truckee River; Pyramid Lake; Lahontan Reservoir; and public health.
- The effects of the Master Project on the endangered cui-ui and the threatened Lahontan cutthroat trout and the Department of Interior's program to conserve these two species.
- The environmental, social, cultural and economic impacts of the conveyance and land application of effluent.
- The institutional and environmental effects of any reductions in Truckee River flow that could result from a change in point effluent discharge.
- The effects on Truckee River water quality and quantity associated with a proliferation of package wastewater treatment plants and growth in Truckee Meadows and outlying communities from no action.
- The general effects on development, air quality, water supply and the quality of life in the Truckee Meadows from JWPCP capacity expansion.

Project Objectives

An important element of any project is its objectives. Well-defined objectives are essential to establishing a rationale for a project and later to provide guideposts to determine whether alternatives are viable and/or justifiable. The following objectives appear to be important to the resolution of wastewater-related problems in the Truckee River basin.

- Provide a cost-effective, institutionally agreeable sewerage system that provides adequate wastewater treatment and disposal for the 20-year planning period for the Cities of Reno and Sparks.
- To improve the quality of water in the Truckee River.
- To optimize the beneficial reuse of treated effluent.
- To minimize the adverse environmental, social, cultural, and economic effects of wastewater disposal and treatment capacity expansion.
- Avoid jeopardy to the endangered cui-ui and threatened Lahontan cutthroat trout.

Purpose and Necessity of This EIS

The relationships between issues and project objectives suggest that the project can have significant environmental consequences both beneficial and adverse. These benefits and adverse impacts represent trade-offs of great concern to the public and therefore require full disclosure and discussion.

The National Environmental Policy Act of 1969 (NEPA) requires "all agencies of the federal government to the fullest extent possible carry out the provisions of NEPA by building into agency decision making appropriate and careful consideration of the environmental effects of proposed actions and avoiding or minimizing the adverse effects of these actions". The environmental review document, in this case EIS, is to be a "full disclosure" document and must follow specific regulations of the Council on Environmental Quality (CEQ), as contained in 40 CFR, Part 6 and published in the Federal Register, Vol. 43, No. 230, November 29, 1978, and of the EPA, as contained in the Federal Register, Vol. 44, No. 216, November 6, 1979. It is the intent of NEPA that alternatives be evaluated and a plan selected on the basis of all environmental considerations, not just monetary costs.

The EIS is a required element of EPA's action on the Reno-Sparks JWPCP Master Project. Under terms of Section 201 of the Clean Water Act, local facilities construction projects are eligible to receive up to 75 percent federal funding for the planning, design and construction of municipal wastewater treatment systems. Up to 85 percent funding can be received for innovative processes. Eligibility is based largely on EPA regulations and guidance memoranda. Before the grant funds are made available, EPA and NDEP must consider the environmental consequences of the proposed project and its viable alternatives. This EIS has been prepared to evaluate the costs and environmental impacts and to encourage public participation in the planning process through local meetings and public hearings.

Laws, Rules and Policies Affecting the Master Project

The following pages briefly describe major federal, state and local laws, regulations and policies that affect the Cities of Reno and Sparks' plans to expand and upgrade the JWPCP.

Federal Laws, Policies and Regulations

Clean Water Act. EPA is charged with administration of the Clean Water Act of 1977. The goals of the act are to achieve fishable, swimmable surface waters throughout the nation by 1983 and to achieve no discharge of pollutants by 1985. The act requires that all discharges to U. S. waters be issued a permit under the National Pollutant Discharge Elimination System (NPDES). In the State of Nevada, the NPDES permit authority was transferred from EPA to the NDEP. The NDEP is responsible for development, issuance and enforcement of the NPDES permits. EPA has retained a review and approval capacity.

Several alternatives being considered for the Master Project include discharges to navigable surface waters, and therefore, the discharge must comply with an NPDES permit issued specifically for the Master Project. An NPDES permit to be in effect after July 1983, after the Master Project goes on line, has not yet been issued for the JWPCP.

Section 201 establishes a construction grant funding program for publicly-owned municipal wastewater facilities (a federal funding of 75 percent with a maximum of 85 percent for "innovative" wastewater treatment and/or disposal concepts). In order to receive grants under Section 201 of the Clean Water Act, Reno and Sparks must conduct their planning according to strict guidelines enforced by EPA and NDEP. In order to comply with these mandates, the Cities of Reno and Sparks prepared a facilities plan for the expansion and upgrading of the JWPCP based on effluent quality limitations recommended by PEL (1979).

Endangered Species Act. The central purpose of the Endangered Species Act of 1973 (ESA) is to halt and reverse the trend toward species extinction through limitations on the actions of federal agencies. By enacting the ESA, Congress made a conscious decision to give endangered species priority over the "primary missions" of federal agencies. The ESA states that each federal agency shall ". . . ensure that any action authorized, funded or carried out by such agency does not jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary to be critical, unless such agency has been granted by exemption for such action by the Committee". The ESA also requires that all federal agencies consult with the Secretary to achieve these ends and the Secretary must issue an opinion on how the agency action will affect the species and how the impacts could be avoided. If the opinion indicates that the agency action may jeopardize a listed species or critical habitat, the agency must either modify its action or apply for an exemption from the ESA.

Nonfederal entities contracting with a federal agency may also be subject to the ESA provisions as well. Provisions of the ESA may apply even after a project has been built.

The presence of the endangered cui-ui and threatened Lahontan cutthroat trout in the lower Truckee River system is the basis for application of the ESA to federally-funded and regulated projects affecting the river. The ESA clearly has significant implications for the planning and operation of the Master Project. EPA must ensure that Master Project does not jeopardize the continued existence of either species. Specific conservation measures have been worked out between the EPA and the Department of Interior during the consultation required by the ESA relative to the ESP (See Appendix K).

Even if the EPA could avoid the ramifications of the ESA during the planning and construction stages of the Master Project, it is possible that the operation of the plant, at least initially, will be subject to ESA requirements (see Appendix C). The plant will require a NPDES permit and although this permit will be issued by the State of Nevada, the water quality standards under which it will be issued must be approved by EPA. This may make the standards and the permit subject to the requirements of the ESA. EPA may have an obligation under the ESA to set (or approve) standards which would avoid acute and chronic toxicity and encourage the propagation of the two fish species.

The ESA should not be underestimated in its potential impact on the Master Project. The ESA is strong legislation; violation of any of its provisions exposes the violator to suit by any individual or the Secretary of the Interior. The outcome of such a suit could be the enjoining of project construction and perhaps operation, regardless of project expenditures in time or money.

Clean Air Act. The Clean Air Act Amendments of 1977 require states to prepare plans to attain national ambient air quality standards (NAAQS) in regions where the standards are being violated. These standards are designed to protect human health from the effects of chronic air pollution. Any project that directly or indirectly creates local air pollution conditions in excess of NAAQS or which conflicts with the strategy presented in an approved State Implementation Plan (SIP) may have federal funding withheld under Section 316 of the Clean Air Act. Because federal standards for suspended particulates and carbon monoxide are periodically violated in the Truckee Meadows, an Air Quality Implementation Plan (AQIP) has been prepared.

Safe Drinking Water Act. The Safe Drinking Water Act of 1974 requires EPA to set standards for drinking water quality and to establish guidelines for state regulation and enforcement of these standards. It also gives EPA the responsibility of protecting underground sources of drinking water. National primary drinking water regulations were established by EPA in 1977 and secondary drinking water regulations were established in 1979. Any option of land disposal, surface water disposal or surface storage of wastewater must be analyzed for its effects on local drinking water supplies.

Fish and Wildlife Coordination Act. Under this act, federal agencies involved in projects resulting in modifications of streams or other water bodies are required to protect fish and wildlife resources which may be affected by the project. EPA procedures for implementing NEPA require consultation with the U. S. Fish and Wildlife Service (USFWS) and appropriate state wildlife agencies to develop mitigation measures for adverse impacts.

Historic Preservation Act. Under the Historic Preservation Act of 1966, if federal agencies undertake activities affecting sites of historic, architectural, archeological, or cultural value that are listed on the National Register of Historic Places, then the Advisory Council on Historic Preservation must be consulted and mitigation measures must be developed.

EPA Policy on Wetland Protection. In January 1979, EPA issued a Statement of Procedures on wetlands protection (Executive Order 11990). Under the procedures, EPA is required to assess the impacts of its action on wetlands, specifically the Stillwater and Fernley Wildlife Management Areas for this project, and to avoid or, if no practicable alternative exists, minimize adverse impacts.

EPA Policy on Prime Agricultural Land Preservation. In September 1978 EPA issued its policy to protect environmentally significant agricultural lands. Under this policy, EPA is required to identify the direct and indirect impacts of its actions on prime agricultural lands and to avoid or mitigate, to the extent possible, any adverse impacts.

State Laws, Regulations, and Policies

Nevada Water Pollution Control Law. Regulatory authority for point source control lies at the state level of government in Nevada under the Nevada Water Pollution Control Law of 1973 (NRS 445.131 to 445.354). The primary purposes of this law are to:

1) Restore and maintain the chemical, physical, and biological integrity of water within the state, and

2) Prevent, reduce and eliminate pollution.

Under this law, "except as authorized by a permit issued by the Human Resources Department . . . it is unlawful for any person to discharge from any point source any pollutant into any waters of the State or any treatment works". The State Environmental Commission is responsible for promulgating regulations, water quality standards and effluent limitations as required by this law. The NDEP is designated as the state water pollution control agency and has final authority on water pollution prevention, abatement and control. The law also authorizes the Director to take any actions consistent with those of the Clean Water Act relating to administration of the NPDES by the state. The Division of Fisheries of the Nevada Department of Wildlife also provides input to the NDEP on the implementation of its permit and monitoring programs. Until 1979, this law related only to point sources of pollution. Through AB 8572, the 1979 Nevada State Legislature established a Diffuse Source Control Program for the control of nonpoint sources of pollution as an amendment to the Nevada Water Pollution Law. This program has the authority to regulate existing diffuse sources of pollution causing identified water quality problems and requires all new urban developments to use best management practices in order to obtain a grading or building permit. This law became effective in July 1979, although the regulations are not yet fully developed and will be implemented either through NDEP or municipalities.

Local Laws, Rules and Regulations

As mentioned above, regulatory authority for point source control lies at the state level of government. Local governments are responsible for waste treatment management, specifically for the operation of waste treatment facilities to remove pollutants from wastewater. In order to carry out waste treatment management operations, local agencies, i.e., Reno and Sparks, may adopt specific regulations and ordinances (The Research Group, 1977).

The County Sewage and Wastewater Law (NRS 244.922) gives counties the authority for wastewater management activities once the county reaches a population of 200,000. SB 72 (1979 Legislature) increased the population limit at which this law would be effective from 200,000 to 250,000 (Crowe, pers. comm.). Under this law, the counties have powers related to the construction, operation, maintenance and financing of waste treatment facilities as well as the adoption and enforcement of ordinances, rules and regulations related to the operation of the waste treatment facilities (The Research Group, 1977).

NRS 439.370 requires each county to establish a county board of health to oversee all sanitary conditions in the county. The Washoe County District Board of Health administers septic tank and solid waste landfill regulations (The Research Group, 1977).

Agencies Involved and Public Participation

Data for this EIS were compiled from numerous existing studies of the Truckee River basin, wastewater facilities documents, field reconnaissance, literature review and numerous contacts with involved agencies and individuals. Some of the agencies providing information and assistance in preparation of this EIS include the EPA, Washoe Council of Governments (WCOG), USFWS, Nevada Department of Wildlife (NDW), Colorado Cooperative Fisheries Research Unit (CCFRU), U. S. Geological Survey (USGS), Desert Research Institute (DRI), Water and Power Resources Service (WPRS), Nevada Division of Water Resources (DWR), the Cities of Reno and Sparks, Kennedy/Jenks Engineers, Inc., and many others.

The EIS process encourages public input into the decision-making process. Two series of public workshops (March 20-22 and April 24-26, 1979) were held prior to preparation of the preliminary Draft EIS. The Draft EIS will be widely circulated by the EPA for public comment, and a public hearing will be held to solicit public responses. The results of the public meetings and hearings and any written comments received will be presented in the Final EIS. The Cities of Reno and Sparks then select their preferred alternative and the decision is then transmitted to EPA for grant funding approval. Final EPA action concerning the grant award to the Cities of Reno and Sparks will be made following a 30-day comment period on the Final EIS.

Study Area Characteristics

Regional Study Area Location

Because the Master Project can potentially affect so many areas, a confined study area cannot be delineated and is thus described as a regional study area.

The study area is located in west-central Nevada and is found primarily within the Nevada portion of the Truckee River basin (Figure 1-1). The area encompasses portions of Washoe, Storey, Churchill and Lyon Counties and is generally bounded by the Virginia, Pah Rah, Sierra Nevada and Truckee Mountains.

Climate

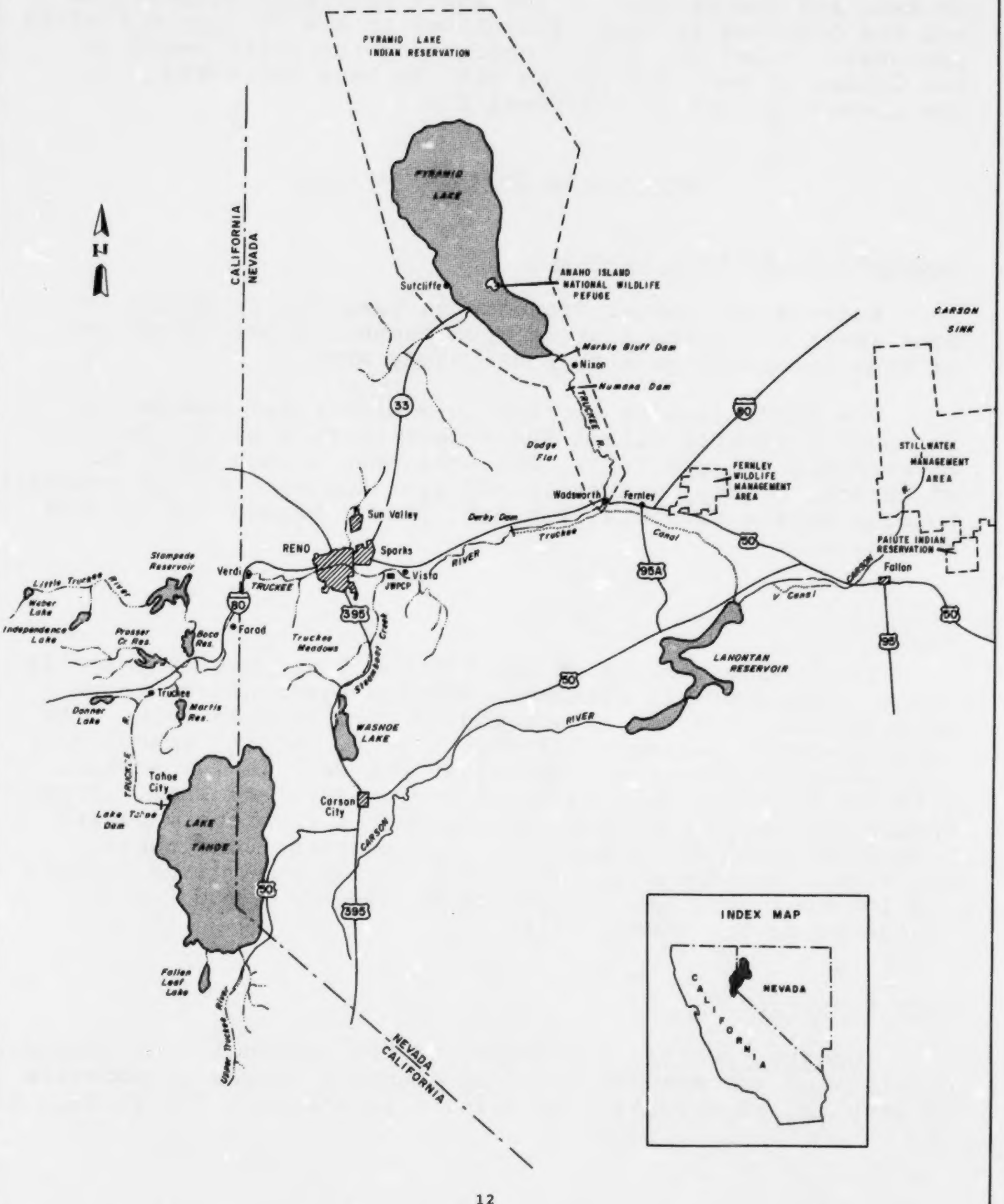
The Nevada portion of the Truckee River basin typically has a mild, semiarid climate. Average temperatures range from 18°F to 45°F in January and 47°F to 91°F in July. The growing season averages 137 days a year. Normal annual precipitation in the water equivalent for Reno is 7.2 inches, with the majority falling in winter as rain and snow. Winds, though extremely variable, are generally light to moderate. Prevailing wind directions are east-southeast and north. Additional meteorological features of the study area include its low humidity, high incidence of sunshine, and rare incidence of fog (NOAA, 1978).

Land Resources

Topography. The topography of the regional area typically consists of north-south trending mountain ranges of moderate to high relief separated by alluviated basins. The valleys have

FIGURE 1-1

REGIONAL AREA



elevations between 3,900 and 5,000 feet and slopes are generally less than 20 percent. The Cities of Reno and Sparks are located in the northwestern portion of the Truckee Meadows, part of a large semiarid plateau. The Truckee River flows through the northern portion of Truckee Meadows. The Truckee River basin, from Derby Dam to Pyramid Lake and including Dodge Flat, covers roughly 50 square miles and is separated longitudinally by the Truckee River. The valley floor is relatively flat and characterized by small irrigated farms interspersed with moderate to steeply undulating rangelands. Pyramid Lake, the terminus of the Truckee River, presently covers approximately 110,000 acres and is bordered by narrow, gravelled terraces on the east and west, by the delta formation on the south and broad mud flats on the north. Fallon is located in the southern portion of the lower Carson River basin, often called Lahontan Valley, which consists of dunes, alkali flats, marsh and irrigated land.

Geology. The Truckee Meadows, the Truckee River corridor immediately adjacent to the Truckee River, the Truckee River Valley and the Lahontan Valley are generally underlain by Quaternary alluvium and valley fill. Much of this alluvium is lake and stream deposits and is composed of gravel, sand and silt, partly contemporaneous with Lake Lahontan deposits (Bonham, 1969; DOI, 1977). In these areas, Quaternary alluvium is generally surrounded by Cenozoic volcanic rocks, with composition ranging from rhyolitic to basaltic. Sediment is often interstratified between these rocks. Areas of locally bleached rocks are also found in the Truckee Meadows area (SCS and USFS, 1972).

The regional area has been and is now structurally active, as shown by faults in even the youngest materials and recent earthquake activity. The Truckee Meadows area and the abrupt decrease in gradient of the Truckee River downstream from Verdi indicates recent and possibly continuing relative uplift of the Virginia Range. Most of the Truckee River basin valleys are structural depressions, and the drainage is largely structurally controlled, dominantly by the many faults. Faults also outline most of the steeper mountain fronts.

Soils. Soils in the Truckee Meadows are generally fine and fine loamy soils occupying alluvial fans. Slopes are generally less than 15 percent and soil depths range from 20 inches to over 40 inches. The SCS land capability unit for agricultural uses ranges from II to IV (SCS and USFS, 1972).

Soils directly bordering the Truckee River through the Truckee River Canyon are typified as coarse, loamy soils associated with alluvial lands, with slopes less than 5 percent. This alluvial area is surrounded by fine and fine loamy, shallow to bedrock soils, occupying stony hills and mountains. Slopes range from 15 to 50 percent (SCS and USFS, 1972).

The soils of Dodge Flat are typically dry dunelands with deep or moderately deep sandy soils and slopes generally less than 5 percent. The water-holding capacity is less than 3 inches and the SCS land capability unit is III. Other portions of the Truckee River Valley have deep, coarse loamy soils occupying alluvial fans with slopes less than 15 percent (SCS and USFS, 1972).

Soils of the Lahontan Valley range from sandy to clay loams, most being slightly to strongly saline. The land capability unit ranges from II to IV, indicating very good to fair cultivation value (DOI, 1977).

Land Use. Much of the Truckee Meadows is urban. Other major land uses, from largest to least acreage, include: pasture, alfalfa, recreation (i.e., parks, golf courses) and grain. Large tracts of land in the Fernley/Wadsworth and Fallon areas are used for alfalfa and pasture. Small irrigated farms are also located along the Truckee River corridor and in the Truckee River Valley. The remainder of the land in the study area is used for livestock grazing.

Water Resources

Truckee River. The Truckee River basin, a closed system, lies within the States of California and Nevada. The Truckee River originates in the Sierra Nevada Range at the outlet of Lake Tahoe and terminates at Pyramid Lake, a remnant of Lake Lahontan that covered much of the Great Basin during the Pleistocene Period.

In addition to Lake Tahoe, the system has many perennial and intermittent streams draining the eastern slopes of the Sierra Nevada Range and the Carson, Virginia and Pah Rah Ranges. The main tributaries within California are Donner, Prosser, and Martis Creeks and the Little Truckee River, and in Nevada are Grey, Bronco, Dog, Hunter and Steamboat Creeks.

The Truckee River is currently regulated by a series of dams for storage, irrigation and flood control. Dams located on the Truckee River or on tributary streams in California include Lake Tahoe (1870, modified 1910), Donner

Lake (1877), Independence Lake (1879), Boca Reservoir (1939), Prosser Creek Reservoir (1962), Stampede Reservoir (1970), and Martis Creek Reservoir (1972). Derby Dam (1905) and Numana Dam, both diversion dams, are located below Reno. Numana Dam diverts water to Indian Ditch for irrigation purposes. Derby Dam diverts Truckee River water to the Truckee Canal which then transports it to the Carson River via Lahontan Reservoir for irrigation purposes. This diversion varies in quantity throughout the year and, during some months, the total Truckee River flow at Derby Dam is diverted to the Carson River basin. Water from the Truckee River is also diverted in the Truckee Meadows for domestic, industrial and agricultural needs. Over the years some 35 separate diversions have existed, but in 1977 only 17 were operating. Return flows generated by these diversions are discharged to the river by the North Truckee Drain and Steamboat Creek, which enter the Truckee River immediately above Vista.

The designated beneficial uses of the Truckee River below Vista, adopted December 11, 1979, are: agriculture, aquatic life, bathing and water contact sports, boating and aesthetics, drinking water supply, industrial supply and wildlife propagation. Periodically, the Truckee River below Vista does not meet the water quality requirements for some of the designated downstream beneficial uses. In 1977 periodic water quality problems below Vista included high temperatures, pH, BOD, phosphorus, nitrogen, nitrite and ammonia, zinc and low dissolved oxygen (PEL, 1979).

The three major sources of man-induced pollution discharged to the Truckee River in Nevada are the Reno-Sparks JWPCP, runoff from agricultural activities, and runoff from urban communities (WCOG, 1978b). Land use projections for the Truckee Meadows indicate that a majority of the Truckee Meadows and nearly all of the Truckee River Canyon west of Reno, presently used for agricultural purposes, will be converted to urban uses. As a consequence, the discharge of the Reno-Sparks JWPCP and urban stormwater runoff will become the dominant influences on Truckee River quality.

Truckee Canal. The flow of the Truckee Canal is used primarily for irrigation of the Truckee and Carson divisions of the Newlands Project. Water is diverted directly from the Truckee Canal or temporarily stored in Lahontan Reservoir and released later to meet these irrigation demands. Just prior to discharge into Lahontan Reservoir the flow remaining in the Truckee Canal may also be diverted through the powerhouse at Lahontan Dam, discharging below the dam for eventual irrigation use. The water not diverted as above is discharged into Lahontan Reservoir at a point near the dam. During the irrigation season when water is constantly released from Lahontan Reservoir to meet irrigation demands, the Truckee Canal inflow to Lahontan Reservoir may be immediately released through the dam. Water quality in the Truckee Canal at any one time generally reflects that in the Truckee River.

Pyramid Lake. Pyramid Lake, located on the Pyramid Lake Indian Reservation, is a large, deep, saline-alkaline water body covering approximately 110,298 acres. It contains about 93 x 10^{10} cubic feet of water and is approximately 25 miles long, 4-10 miles wide, and 338 feet deep at its maximum. The Truckee River is the lake's primary source of water with small additional amounts of water entering the lake from snowmelt and springs. The only outflow from the lake is evaporation.

Since 1905, the Newlands Reclamation Project, authorized for the irrigation of land in the Carson and Truckee watersheds, has diverted water from the Truckee River to the Carson River through the Truckee Canal, decreasing the flows to the lake by about half. This led to an accelerated decline in the lake level over what would be expected due to natural climatic fluctuation alone. Increased water uses upstream also contributed to reduced Truckee River flow and the decline in lake level. Between 1905 and 1976 the level of Pyramid Lake receded a total of 21 m (69 feet). Accompanying the water loss has been an increase in TDS of 1,276 mg/l, resulting in a current concentration of 5,200 mg/l.

Pyramid Lake supports a number of valuable wildlife resources including the endangered cui-ui, indigenous only to Pyramid Lake; threatened Lahontan cutthroat trout, largest of the cutthroat trout and a valuable game fish; Anaho Island National Wildlife Refuge, valuable colonial nesting bird habitat; and a number of other fish species. Increased additions of nutrients, salts and toxic substances or reduced flows to the lake resulting from the Master Project could adversely affect the lake's ecosystem and these resources.

Lahontan Reservoir. Lahontan Reservoir is located in the Carson River channel approximately 45 miles southeast of Reno. It is 17 miles long and of variable width. The reservoir has a surface area of 12,600 acres and 65 miles of shoreline when full. Its maximum depth is 112 feet.

The water stored in Lahontan Reservoir originates from the Carson River and, via diversions created by Derby Dam and transported by the Truckee Canal, from the Truckee River. An historical account of the development of Lahontan Reservoir can be found in DOI (1977).

The water quality data obtained by EPA show seasonal changes in dissolved oxygen (DO), pH, and the algal-stimulating nutrients nitrogen and phosphorus, which correspond with temperature stratification and destratification. Nitrate has been suggested as the limiting nutrient in Lahontan Reservoir (CRBCOG, 1978) and would appear to perhaps be so based on the EPA data. However, the NDW data show nitrate concentrations too high to be limiting. The water quality parameter with the greatest potential significance to the biology of the reservoir is DO. Midsummer DO in the reservoir approaches the minimum concentration (5 mg/l) required by trout. Lahontan Reservoir is inhabited by both rainbow and brown trout.

A warmwater fishery has developed as a result of prevailing warm temperatures and areas of shallow water. The fishery is supported primarily by white bass and white catfish. Lahontan Reservoir is the fourth ranked fishery in Nevada according to data compiled by the NDW (DOI, 1977).

Groundwater. The Truckee Meadows groundwater basin consists of accumulated sedimentary deposits, or valley fill, underlying the general Reno-Sparks area to maximum depths exceeding 1,000 feet. The most productive aquifer material is found in the upper 300 feet or so of the valley fill. Well capacity ranges from less than 50 gallons per minute (gpm) to several thousand gpm. Principal recharge to Truckee Meadows groundwater is from irrigation and stream channel percolation. Groundwater discharge is through well pumping accretions to the Truckee River, and evapotranspiration from near-surface water tables. Generally, subsurface movement is toward the lower portion of the east valley. Groundwater levels have declined with the increase in well usage, and recharge to the Truckee Meadows groundwater basin has decreased as irrigation and associated seepage losses declined in recent years. The perennial supply has been estimated to be approximately 13,000 acre-feet per year or less.

Objectionable concentrations of arsenic and manganese commonly occur in groundwater below depths of about 250 feet in the eastern portion of the Truckee Meadows basin. In the western portion, excessive arsenic and fluoride concentrations, and high water temperatures occur. The best quality groundwater lies in a central area of the Truckee Meadows.

The Fernley area is underlain by a sequence of lake sediments extending to probable depths of 1,000 feet or more, the upper 200 to 300 feet of which were deposited by the ancient Lake Lahontan. Recharge is derived mainly from percolation of irrigation water from the Truckee Canal and distributary canals and from subsurface inflow. The water table responds directly to the irrigation cycle and associated recharge, reaching peak highs during the August-September period.

Groundwater below depths of 50-60 feet is generally of satisfactory quality along the flank of the Virginia Range south of Fernley but becomes increasingly mineralized and eventually unsuitable as it moves north. Shallow groundwater is usually acceptable for most uses, but is susceptible to changes in the make-up of irrigation waters due to ready surface seepage. Groundwater is pumped for Fernley's municipal supply from a depth between 90 and about 200 feet in the better quality, deeper zone.

Terrace deposits of the Truckee River directly underlie the Town of Wadsworth and form very productive aquifers. At high river flow stages, Truckee River percolation replenishes shallow aquifers. Increased well usage increases such percolation. Groundwater levels are directly influenced by river percolation in Truckee River flows. It therefore follows that the quality of groundwater reflects that of river flows and would probably be affected by significant changes in the quality of such flow.

Groundwater tables in the Lahontan Valley are generally high, about 3-5 feet below ground level in most areas. Recharge is from seepage from irrigation water, Carson River and Lahontan Reservoir. Groundwater quality in the upper zone (0-3' depth) is generally sufficient for domestic use, supporting many domestic wells, although some areas have become too saline for domestic use. The quality of the deeper zones is generally brackish and not suitable for domestic or agricultural uses.

Biological Resources

Flora.

The most common and widespread plant community in the regional area is big sagebrush-grass, occurring primarily in the western two-thirds of the Nevada portion of the Truckee River basin. Chief species in this community are big sagebrush, green rabbitbrush, spiny hopsage, Nevada ephedra, littleleaf horsebrush, antelope bitterbrush, sandberg bluegrass, Nevada bluegrass, and thurber needle grass (SCS and USFS, 1972).

The salt-desert-shrub community, the second largest in the regional area, primarily occupies the eastern third of the Nevada portion of the Truckee River basin in the Lahontan Valley. The principal species are Bailey's greasewood, shadscale, bud sagebrush, spiny hopsage, Indian ricegrass, and cheatgrass. Grasses and forbs associated with this site are few and widely scattered (SCS and USFS, 1972; Lorain, 1980, pers. comm.).

Other plant communities in the regional area include pinyon-juniper, confined mainly to the upper elevations of the Virginia, Pah Rah and Flowery Ranges and Virginia Mountains; mountain brush-grass, confined to the upper elevations in the Virginia Mountains and on Peavine Mountains; rabbitbrush-greasewood, occurring principally on bottom lands of Washoe and Spanish Springs Valleys and the lower reaches of the Truckee River and riparian/wetland found along the Truckee River, and Lahontan Valley and, to a lesser extent, eastern Truckee Meadows (SCS & USFS, 1972; Lorain, 1980, pers. comm.).

Fauna. The plant communities found in the area provide habitat for a variety of wildlife species that have adapted to the characteristically dry climate. Great horned owls, barn owls, burrowing owls, American kestrels and red-tailed hawks are representative of raptors found in the area. Common passerine birds found in the study area include sage thrashers, horned larks, meadow larks, swallows, ravens, jays, magpies, wrens and numerous species of sparrows. Golden eagle and prairie falcon aeries have also been documented in the area (Herron, 1979, pers. comm.). Characteristic mammals are Townsend ground squirrel, Great Basin kangaroo rat, black-tailed jackrabbit, coyote and mule deer. Common reptiles include the Great Basin rattlesnake, common garter snake, and Great Basin fence lizard (WCOG, 1978b).

The Truckee River below Verdi supports both native and introduced game and nongame fish species. The principal game fish found in the system include brown trout, Lahontan cutthroat trout, rainbow trout, mountain whitefish, Sacramento perch, largemouth bass and black crappie, of which only the Lahontan cutthroat trout and mountain whitefish are native. Native nongame species include the tui chub, Lahontan redside, speckled dace, Tahoe sucker, Lahontan mountain sucker, and Paiute sculpin. The golden shiner, mosquitofish and carp are introduced nongame species.

Of the game fish that are found in the Truckee River system below Verdi, the brown trout, mountain whitefish and rainbow trout principally reside in the colder waters above Derby Dam, the remainder principally residing below Derby Dam. The endangered cui-ui uses the river below Derby Dam. Recent studies conducted by the USFWS found that the greatest species diversity and biomass occurred from Steamboat Creek to Derby Dam and overall abundance was highest from Derby Dam to Pyramid Lake.

The river reach between Vista and Derby Dam is important for sport fishing and is currently stocked with rainbow and brown trout by the NDW. Other important game species besides the Lahontan cutthroat trout inhabit Pyramid Lake and the reach below Derby Dam.

Endangered and Threatened Species. Two fishes indigenous to the Truckee River system are classified as endangered or threatened. The cui-ui (*Chasmistes cujus*) was listed as endangered on March 11, 1967. A recovery team has been assigned for the cui-ui, although critical habitat has not been determined. The primary reason for the decline of cui-ui was the destruction of spawning habitat resulting from the operation of Derby Dam and numerous other diversions of Truckee River water. These diversions resulted in a decline in the level of Pyramid Lake and the formation of a silt delta across the mouth of the Truckee River which virtually eliminated the upstream migration of cui-ui. Cui-ui reproduction is now limited to suitable spawning habitat in Pyramid Lake and probably the Truckee River in above-normal water years.

The Lahontan cutthroat trout (*Salmo clarki henshawi*) was initially listed as endangered on October 3, 1970 but was reclassified on July 16, 1975 to threatened status. Like the cui-ui, water pollution and the formation of a silt delta at the mouth of Pyramid Lake led to the decline and eventual extinction of naturally reproducing Lahontan cutthroat trout in the Pyramid Lake-Truckee River system. The population of cutthroat trout presently found in Pyramid Lake is a result of artificial reproduction and a local stocking program. Efforts are presently being made to reestablish both the cui-ui and Lahontan cutthroat trout as naturally sustaining populations.

The endangered bald eagle (*Haliaeetus leucocephalus*) infrequently use wetlands in the area and the Truckee River corridor. The endangered peregrine falcon (*Falco peregrinus aratun*) migrate through the area and have been seen in the Spanish Springs Valley (Herron, pers. comm.). Species classified as protected by the State of Nevada which are known to occur in or infrequently use the study area include beaver, kit fox, Sierra red fox, mink, pigeon hawk, snowy plover, burrowing owl, golden eagle, and white pelican (Herron, pers. comm; Fish and Game Commission, 1977).

Air Quality

Truckee Meadows is in violation of National Ambient Air Quality Standards (NAAQS) for carbon monoxide and particulate matter. Automobiles have been identified as the major source of hydrocarbon (precursor of ozone) and carbon monoxide emissions while fugitive dust categories (e.g., construction and automobile traffic on paved and unpaved streets) have been identified as the major source of particulate matter emissions. The Truckee Meadows Air Quality Implementation Plan (WCOG, 1978a) has evaluated and recommended strategies for the control of these source categories.

Chapter 2

EXISTING WASTEWATER CONVEYANCE, TREATMENT, AND DISPOSAL IN THE TRUCKEE MEADOWS

Existing NPDES Permit

The Reno-Sparks JWPCP operates under NPDES Permit No. NV0020150, which was issued in April 1977 as a two-step permit; the first step being applicable from May 1, 1977 to June 30, 1977, and the second step from July 1, 1977 to April 30, 1982. The May 1, 1977 to June 30, 1977 portion was for a flow of 20 mgd, and included requirements for biochemical oxygen demand (BOD), solids, coliform bacteria, DO, and Ph, but did not contain requirements for phosphorus or nitrogen. The July 1, 1977 to April 30, 1982 portion increased the allowable flow to 24 mgd, but was a much more stringent permit. The requirements for BOD, suspended solids (SS), and DO were made more stringent, and discharge limitations were added for total dissolved solids, residual chlorine, phosphate, toxicity, and receiving water temperature after addition of plant effluent. Table 2-1 presents the requirements contained in both portions of the 1977 NPDES permit, which was superseded by the presently valid interim permit. It is expected that a new permit will be issued when the interim permit expires. The probable limitations of the new permit are discussed in Chapter 3.

In September 1977, the NDEP issued a Finding of Violation for failure to comply with the effluent limitations in the second portion of the 1977 permit. The key effluent limitation violated was phosphate, and this violation occurred because the JWPCP was not designed for phosphorus removal. As a result of the Finding of Violation, the interim NPDES permit was issued which contained a compliance schedule for meeting discharge limitations. A key portion of the compliance schedule is completion of the ESP facilities. With the exception of flow, which was increased from 20 mgd to 24 mgd, and a chlorine residual limitation of 0.01 mgd, the requirements of the interim permit are the same as May 1, 1977 to June 30, 1977 requirements. This interim permit is valid until May 1982.

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Table 2-1

NPDES PERMIT NO. NV0020150
(originally issued April 1977) LIMITATIONS

		April 1977 Permit				Interim Permit	
		Effective 5/77 to 6/77		Effective 7/77 to 4/82		9/77-5/82	
Parameter	Unit	30-day Average	Daily Maximum	30-day Average	Daily Maximum	30-day Average	Daily Maximum
Flow	mgd	20	-	24	-	24	-
BOD (5-day, 20°C)	mg/l	10	-	-	10	10	-
SS	mg/l	20	-	-	10	20	-
Settleable Solids	ml/l	0.1	0.2	0.1	0.2	0.1	0.2
TDS	mg/l	-	-	150	175	-	-
Phosphate (PO_4)*	mg/l	-	-	0.5	0.6	-	-
Nitrate (NO_3)**	mg/l	-	-	-	5	-	-
Fecal Coliform	#/100 ml	200	2,000	200	2,000	200	2,000
DO	mg/l	>6.0 at all times		>6.5 Jun-Sep >6.0 for any sample		>6.0 at all times	
Chlorine Residual (Cl_2)	mg/l	-	-	-	.01	-	.01
Temperature - Jun-Sep	°C	-	-	17	22	-	-
Oct-May		-	-	-	14	-	-
pH		6.5-8.5 at all times		6.5-8.5 at all times		6.5-8.5 at all times	

* Phosphate limits of 0.5 and 0.6 mg/l as PO_4 are equivalent to 0.16 and 0.2 mg/l as P, respectively.

** A nitrate limit of 5 mg/l as NO_3 is equivalent to 1.13 mg/l as N.

Wastewater Treatment in the Truckee Meadows

Wastewater treatment in the Truckee Meadows is accomplished by one of three different concepts: individual subsurface disposal systems (septic tanks); package treatment plants; or the Reno-Sparks JWPCP. Individual subsurface disposal systems (septic tanks) are often used for treatment in low density areas where subsurface conditions permit. For higher density residential or commercial developments which are not served by the JWPCP, package wastewater treatment plants are used, and regional treatment at the JWPCP is provided for remaining wastewater flows which are not treated by subsurface systems or package plants. The present year 2000 and ultimate sewer service areas for the JWPCP are outlined on Figure 2-1. At the present time, the estimated division of wastewater flow within the Truckee Meadows to each of these methods of treatment is about 16 percent to septic tanks, 4 percent to package plants and 80 percent to the JWPCP.

Individual Disposal Systems (Septic Tanks)

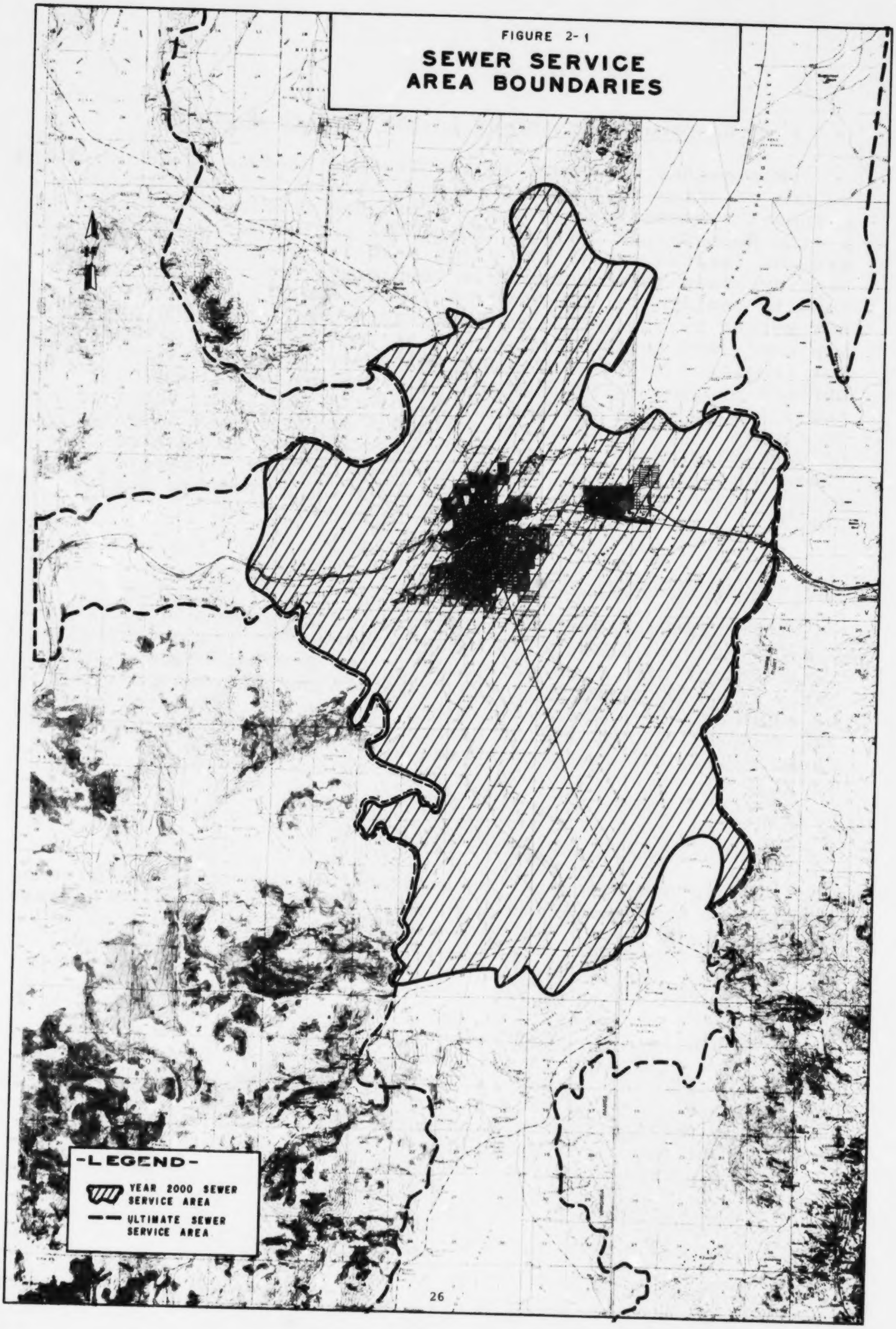
A traditional method of wastewater treatment in low density housing areas is the septic tank. Of the estimated total 25 mgd of sewage generated in the Truckee Meadows in early 1980, approximately 4.0 mgd or 16 percent was treated by septic tanks. These treatment systems are regulated by the Washoe County District Health Department (WCDHD) via their individual sewage disposal system regulations of May 1975.

Package Wastewater Treatment Plants

The second approach to wastewater treatment in the Truckee Meadows is the use of small treatment facilities called package plants. Such plants are purchased preassembled from a manufacturer and generally only require minor construction and installation labor to place them in operation. Because they are purchased preassembled, they are customarily referred to as "package plants". In early 1980, package wastewater treatment plants treated an estimated 4 percent of the wastewater flow generated in the study area. These plants serve both domestic and commercial developments and are permitted by the NDEP. At the present time, the City of Sparks will not allow package plants within its city limits, whereas the City of Reno and Washoe County will.

FIGURE 2-1

SEWER SERVICE AREA BOUNDARIES


-LEGEND-
▨ YEAR 2000 SEWER SERVICE AREA
— — ULTIMATE SEWER SERVICE AREA

Before a package plant can be installed several conditions must be met. First, the Package Plant Review Committee, which consists of the Cities of Reno and Sparks, Washoe County, WCDHD, WCOG, and NDEP, must recommend approval of the installation. It should be noted that this committee was established in December 1978 in response to the ESP grant conditions, and prior to this time was not a factor in the decision-making process. Second, the jurisdiction in which the proposed plant would be located (Reno or Washoe County), must approve the project. Third, for package plants using a surface discharge concept, after receiving the above approvals it is then necessary to obtain a NPDES permit from the NDEP.

The Package Plant Review Committee was established in response to ESP grant condition 9f and is intended to function until the Master Project facilities are in operation. The Committee imposes requirements on approval of any package plant such that approvals will not result in degradation of water quality or reduction in water quantity in the Truckee River and will not otherwise result in adverse environmental impacts. Applicants are required to provide project and process data, financial programs and a plan for assuring extended operation and maintenance service. The committee, with the data provided, then recommends approval or rejection of the intended project to the affected jurisdiction. NPDES discharge applications will not be accepted for any plant that has not been acted upon by both the Package Plant Review Committee and the affected jurisdiction.

A review of the permits and permit applications on file with the NDEP indicates that in January 1980 there were 14 package wastewater treatment plants either under construction or operating in the Truckee Meadows area. The combined treatment capacity for these 14 plants is about 1.5 mgd. A summary of the characteristics of these plants and their discharge limitations is presented in Table 2-2. Figure 2-2 illustrates the locations of these existing plants.

Permits for the existing plants have generally been written for effluent limits of 30 mg/l for BOD and SS, and 200 coliform organisms/100 ml. However, where the potential for contamination of the Truckee River was believed to be possible, more stringent BOD and SS limits of 10 mg/l were imposed. Phosphorus and nitrogen limits have also been imposed or are proposed in certain cases. Most of the existing systems use the extended aeration process and discharge effluent to leach fields or percolation ponds. Sludge disposal locations are not indicated in the permits but sludge must be disposed of at a landfill approved by the WCDHD or by another approved and environmentally acceptable option.

Table 2-2

EXISTING PACKAGE PLANT WASTEWATER FACILITIES IN THE TRUCKEE MEADOWS AREA

IDENTIFICATION			SERVICE AREA			PLANT CHARACTERISTICS				REGULATORY						
				Dwelling Units		Capacity, mgd					Permit Limitations, mg/l					
		Permit Status	Estimated Population	Quantity	Type	Average	Design	Liquid Treatment & Disposal	Solids Treatment & Disposal	Local Jurisdiction	BOD_5	TSS	Tot P	Tot N	Cl_2	MPN
1.	CDB Services	Issued	2,100	—	—	0.075	0.083	OD, S	Landfill	Washoe	30	-	-	-	-	-
2.	Boomtown	Issued	Varies	122	Commercial	0.30	0.35 0.35	ST, LF EA, LF	Landfill	Washoe	10	10	-	-	-	-
3.	Lemmon Valley	Issued	3,960	1,050	SF/Multi	0.12	0.30	EA, LF	None indicated	Washoe	30	-	-	-	-	200
4.	C&R Mobile Homes	Issued	200	100	Mobile	0.013	0.013	Lagoons, LF	None indicated	Washoe	-	-	-	-	-	-
5.	Glen Meadows	Pending**	—	239	Mobile	0.07	0.09	Lagoons, Irrigation	None indicated	Washoe	-	-	-	-	-	-
6.	Frontier Estates	Issued	60	14	SF	-	0.0067	S, LF	None indicated	Washoe	-	-	-	-	-	-
7.	West Plumb Lane Estates	Pending**	—	—	—	0.047	—	—	—	Washoe	-	-	-	-	-	-
8.	Horizon Hills GID	Issued	250	—	—	0.58	0.58	EA, LF	None indicated	Washoe	30	30	-	-	-	200
9.	Meadow Ridge	Issued	750	—	—	0.02	0.02	Aquionics, LF	Landfill	Reno	10	10	-	-	-	200
10.	Sierra Hills	Issued	500	137	—	0.07	—	EA, LF	None indicated	Reno	30	30	-	-	-	200
11.	River Inn	Issued*	—	—	Commercial	0.045	0.045	EA, RI	Landfill	Washoe	10	10	2	3	-	25
12.	Indian Hills	Pending**	—	—	SF	0.08	0.08	EA, RI	Landfill	Washoe	-	-	-	-	-	-
13.	Spanish Springs Estates	Pending**	—	—	Mobile	0.049	0.049	EA, LF	Landfill	Washoe	30	30	-	-	-	-
14.	Washoe Meadows	Pending**	—	—	SF	0.07	0.07	LF	Landfill	Washoe	10	10	-	10	-	-

LEGEND

SF	- Single Family
Multi	- Multi Family
Mobile	- Mobile Homes
OD	- Oxidation Ditch
EA	- Extended Aeration
ST	- Septic Tank
CS	- Contact Stabilization
LF	- Leach Field
S	- Stream Disposal
AN	- Anaerobic Digestion
SDB	- Sand Drying Beds
RI	- Rapid Infiltration

* Under Construction

** Approved by Package Plant Review Committee but not under construction

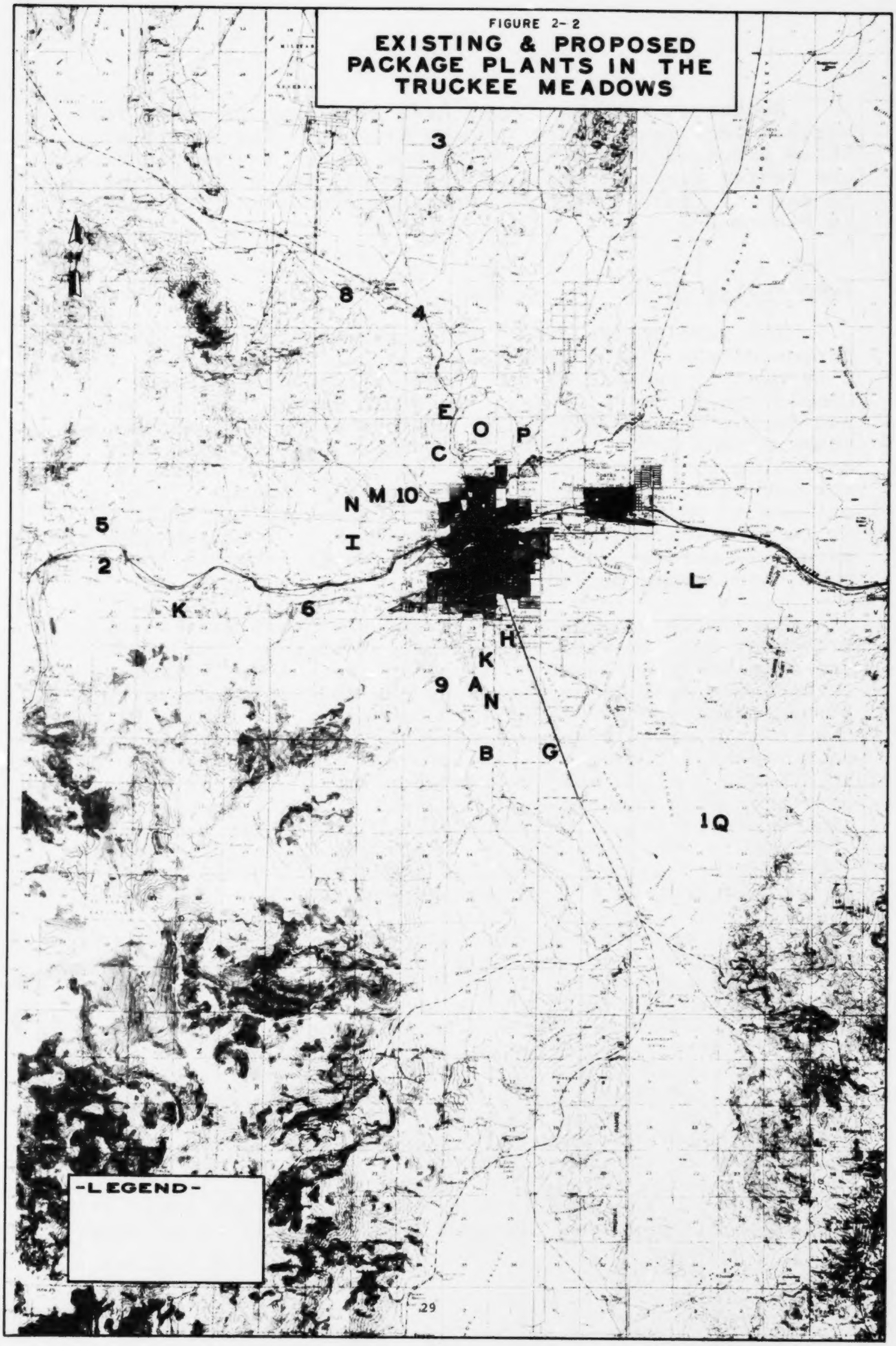


FIGURE 2-2
EXISTING & PROPOSED PACKAGE PLANTS IN THE TRUCKEE MEADOWS

Seventeen package plants have also been proposed for various locations in the Truckee Meadows. The status of these proposed plants is at various stages in the planning and review process. Table 2-3 presents the characteristics of each of these 17 plants, and their locations are shown in Figure 2-2.

Reno-Sparks JWPCP

The Reno-Sparks JWPCP was constructed by equal participation of the Cities of Reno and Sparks and therefore, each city owns 50 percent of the treatment capacity. Since its completion in 1967, Sparks, the NPDES permit holder, has had direct responsibility for the operation and maintenance (O&M) of the JWPCP. Costs for O&M are paid by each city according to its proportion of the plant flow. From 1977 through 1979, the City of Reno generated about 15.39 billion gallons of wastewater and the City of Sparks 4.6 billion gallons of wastewater. Consequently, Reno contributed approximately 77 percent and Sparks 23 percent of the O&M costs over this 3-year period.

The JWPCP provides primary and secondary wastewater treatment for domestic and industrial wastes. The plant was originally designed to treat an average daily flow of 20 mgd, but will be permitted by the NDEP to treat up to 24 mgd until the ESP facilities become operational. Briefly, the initial waste treatment consists of comminution and flow measurement followed by grit removal. Following this preliminary treatment, in-line basins provide primary settling, subsequent aeration using the conventional activated sludge process and final clarification. Postaeration for oxygenating the effluent is provided prior to chlorination. Dechlorination with sulfur dioxide is provided prior to disposal to Steamboat Creek, a tributary to the Truckee River.

Sludge generated in both the primary and secondary treatment processes is treated on-site by anaerobic digestion. Prior to November 1978, all sludge was dried on sand drying beds and then the dried sludge was stockpiled on city-owned land across Steamboat Creek from the plant. In November 1978, the practice of storing the sludge adjacent to the plant was halted by the NDEP and a program was initiated to haul all stockpiled sludge to the Mustang landfill, which is about 10 miles from the JWPCP. The stockpiled sludge was removed between November 1978 and January 1979. The practice of drying the sludge on the sand beds and then hauling the dried sludge directly to the Mustang landfill, however, was prohibited in April 1979 by the NDEP. Since April 1979 liquid sludge has been injected into the soils of 80 acres

Table 2-3

PROPOSED PACKAGE PLANT WASTEWATER TREATMENT FACILITIES FOR THE TRUCKEE MEADOWS AREA

IDENTIFICATION			SERVICE AREA			PLANT CHARACTERISTICS				REGULATORY					
				Dwelling Units						Permit Limitations, mg/l					
	Permit Status	Project Status	Projected Population	Quantity	Type	Design Capacity, mgd	Liquid Treatment & Disposal	Solids Treatment & Disposal	Local Jurisdiction	BOD_5	TSS	Tot P	Tot N	Cl_2R	MPN
A. Lake Ridge Terr. #4	Issued	Active	50	14	—	0.096	EA, LF	None indicated	Reno	30	30	-	-	-	200
B. Canepa - Faretto	Pending	Active	100	30	SF	0.0125	EA, LF	None indicated	Washoe	-	-	-	-	-	-
C. Washoe Vista	Pending	Active	1,500	433	SF/Multi	0.113	EA, LF	None indicated	Reno	-	-	-	-	-	-
D. Warren Estates	Pending	Active	600	174	SF	0.052	EA, LF	SDB, Landfill	Reno	-	-	-	-	-	-
E. Reno Hills	Draft	Inactive	1,250	500	—	0.125	EA, EP	Landfill	Reno	30	30	-	-	-	200
F. Harrah's Auto World	Issued	Inactive	—	-	Commercial	0.50	OD, LF	None indicated	Washoe	30	30	-	-	0.5	-
G. Country Club Est.	Draft	Inactive	1,026	410	SF/Multi	0.040	EA, LF	None indicated	Reno	30	30	-	-	-	200
H. Lakeview Apts.	Issued	Inactive	700	316	Multi	0.10	EA, LF	None indicated	Reno	20	20	-	-	-	200
I. Glenview	Pending	Inactive	1,990	755	SF/Multi	0.15	EA, LF	None indicated	Reno	-	-	-	-	-	-
J. Coit Property	Pending	Inactive	1,800	700	SF/Multi	0.26	Lagoon	None indicated	Reno	-	-	-	-	-	-
K. Belli Ranch	Pending	Inactive	790	242	SF	0.087	EA, LF	None indicated	Washoe	-	-	-	-	-	-
L. Jones Ranch	Pending	Inactive	—	-	—	0.574	Phys-Chem	—	Reno	-	-	-	-	-	-
M. CDB, Inc.	Pending	Inactive	18,300	6,111	Residential	1.97	OD, LF	None indicated	Washoe	-	-	-	-	-	-
N. Carrage Homes	Pending	Inactive	100	24	SF	0.012	EA, LF	None indicated	Reno	-	-	-	-	-	-
O. University Heights	Pending	Inactive	1,000	660	SF/Multi	0.10	CS, LF	None indicated	Reno	-	-	-	-	-	-
P. Aquionics	Pending	Inactive	260	186	Multi	0.026	Aquionics, LF	Landfill	Reno	-	-	-	-	-	-
Q. Meadow View Terrace	Pending	Inactive													

LEGEND

SF - Single Family
Multi - Multi Family
Mobile - Mobile Homes
OD - Oxidation Ditch
EA - Extended Aeration
ST - Septic Tank
CS - Contact Stabilization
LF - Leach Field
S - Stream Disposal
AD - Anaerobic Digestion
SDB - Sand Drying Beds

of city-owned land adjacent to the JWPCP. This practice is anticipated to continue until the new sludge facilities are placed into operation.

Costs for wastewater treatment are borne initially by the City of Sparks and consequently Sparks is responsible for budgeting and cost accounting. Costs for fiscal years 1977 to 1979 are as follows:

Fiscal Year	Flow Treated mg	Expenditures $1,000	Cost* $/mg
1977	6,431.3	990.7	154
1978	6,380.2	1,156.4	181
1979	7,202.9	1,881.0	261
1980	7,500 (est.)	2,100 (est.)	280 (est.)

*The major discontinuity in costs between 1978 and 1979 is caused by the change in method of sludge disposal required by NDEP.

Energy required for heating the sludge digesters is entirely supplied through the production of 200 million cubic feet per year of methane gas in the digestion process. Electrical energy is the largest single cost item in the budget. For fiscal year 1979, $426,000 was expended for electrical energy and $586,000 is budgeted for fiscal year 1980.

Early Start Wastewater Program (ESP). In late 1975, EPA began preparation of an EIS on the August 1975 "Draft Facilities Plan for the Expansion of the Reno-Sparks Joint Water Pollution Control Plant". During the EIS process, EPA determined that additional facilities planning by the cities was required before a grant decision could be made. Meanwhile, the area tributary to the plant was experiencing rapid growth, and the average daily flow to the JWPCP was approaching its design capacity. Recognizing the critical nature of this problem, the City of Reno requested authorization of a program which would allow immediate expansion of treatment components which were common to all viable alternatives then under consideration. In October 1976, EPA authorized preparation of a Facilities Plan and EA for the ESP. A Negative Declaration for the ESP was issued by EPA in March 1977 and on the construction in May 1978. The EPA grant fund offer for the ESP contains several conditions (Appendix J) regarding air quality and the endangered cui-ui and the threatened Lahontan cutthroat trout per the federal Endangered Species Act. Construction began in October 1978 and completion of these facilities is expected in mid-1980.

The ESP consists of the expansion of the plant capacity to 30 mgd and the addition of phosphorus removal capability using the Phostrip treatment concept. The increased capacity will be provided by expanding headworks, grit removal, primary sedimentation, aeration and final sedimentation basins. Sludge treatment will be upgraded by constructing an additional anaerobic digester and adding thickeners for waste-activated sludge. Permanent chlorination and dechlorination facilities will be installed by modifying the existing chlorination facilities.

Current Effluent Quality and Operational Limitations

Wastewater tributary to the Reno-Sparks JWPCP is principally domestic wastewater, with little industrial influence. Wastewater from the gaming establishments is very similar to domestic wastewater, although the former has a higher solids content due to food wastes from the many restaurant facilities associated with the gaming establishments. There are no recorded industries which discharge industrial process water to the sewer system. There are, however, several light industries, such as plating establishments, which handle the disposition of their waste privately and do not contribute process water to the JWPCP.

Wastewater flows and the characteristics of these flows are presented in Table 2-4 for 1977, 1978, and 1979. The influent BOD and SS concentrations in 1977 and 1978 were greater than they had been in earlier years, primarily due to water conservation efforts in these years, as well as the on-going program of storm and sanitary sewer separation.

SS concentrations in the effluent have generally been within the NPDES limits. The BOD_5 of the effluent has consistently exceeded the regulatory limit, although this is a relatively stringent limit compared to most other wastewater treatment plants in the United States. Among the factors leading to the high effluent BOD_5 are: 1) wastewater flow approaching and occasionally exceeding design capacity; 2) influent BOD_5 significantly in excess of the original design criteria of 200 mg/l and, 3) nitrification occurring during the BOD test, beginning between day one or day two. This increase at day one or two is atypical, and not really representative of the pattern of BOD exertion noted for most plants. Tests are also run with the nitrification inhibited in the BOD test, and these tests indicate a 5-day BOD within the NPDES limits. Results for inhibited and uninhibited testing are submitted to the NDEP.

Table 2-4

RENO-SPARKS JWPCP WASTEWATER CHARACTERISTICS

Parameter	1977 Interim NPDES Limit Daily Maximum*	1977		1978		1979	
		Influent	Effluent	Influent	Effluent	Influent	Effluent
Flow-mgd	24	16.6[4]	16.6[4]	19.4	19.4	20.8	20.8
BOD$_5$-mg/1	10	278	20.2	235	22.5	292	20.3
SS -mg/1	20	225	17.8	216	16.3	279	19.9
DO -mg/1	7.9	0.93**	7.74	—	6.35	—	6.5[1]
Cl2 -mg/1	0.01	--	0.28	--	0.002	—	<0.39[2]
NO$_3$-N-mg/1		6.33**	5.53	—	10.3	—	0.28
NH$_3$ -N-mg/1	--	—	—	—	10.0	—	11.6
PO$_4$-P-mg/1		7.07**	5.06	—	4.88	—	6.20[3]
TDS -mg/1		367**	281	446	313	—	270

* The JWPCP is presently being operated under requirements established by the May 1, 1977 to June 30, 1977 NPDES permit. These requirements have been extended until the Early Start Program expansion is completed.
**Average of January - June

1. Average minimum Dissolved Oxygen
2. Average maximum Chlorine residual
3. Total Phosphorus
4. The unusual low flow was caused by drought conditions and water conservation measures.

SOURCE: Kennedy/Jenks Engineers, 1980.

Combined Sewer Separation

Combined sewers carry both wastewater and stormwater to the treatment plant, and are a partial cause of increased wastewater treatment plant flows during storm conditions. The City of Sparks has no known combined sewers in its wastewater collection system. In Reno, however, the older sections of the collection system utilize combined sewers. Reno does have an on-going program for eliminating these combined sewers, and has eliminated about two-thirds of them in the last 12 years. Present expectations are for this separation program to continue, and for virtually all of the combined sewers in Reno to be eliminated by 1983.

Chapter

ALTERNATIVES FOR WASTEWATER TREATMENT AND DISPOSAL

Introduction

The description and comparison of project alternatives in the preparation of an EIS must follow specific regulations of the CEQ as contained in 40 CFR, Part 6 in the Federal Register, Vol. 43, No. 230, November 29, 1978 and of the EPA as contained in the Federal Register, Vol. 44, No. 216, November 6, 1979. The comparative evaluation should include an analysis of the environmental impacts, commitments of resources, costs and societal risks associated with each alternative. The reasons why a proposed alternative management system is finally selected must also be explained in detail. This section contains a description of the alternatives considered for the Master Project and evaluations relative to cost and engineering considerations.

The information on which much of the following discussion is based is contained in Reno-Sparks JWPCP Facilities Plan Update, Progress Report No. 1, January, 1979 by Kennedy Engineers; Progress Report for Alternative Methods of Effluent Treatment and Disposal, Reno-Sparks JWPCP Facilities Plan Task Memorandums No. 1 and 2 by Cooper & Associates (Appendices O and P); and Cities of Reno and Sparks, Expansion of Reno-Sparks JWPCP, Master Project Facilities Plan Draft by Kennedy/Jenks Engineers (1980). The reader is referred to the above documents for more detailed information regarding facilities planning.

Planning Constraints

In developing alternative effluent treatment and disposal systems, it should be recognized that both regulatory and nonregulatory constraints are imposed upon facility selection. The principal constraints influencing the development of alternatives for the wastewater treatment and disposal facilities are:

- PL 95-576 - Federal Water Pollution Control Act, as amended by Clean Water Act of 1977
- EPA Secondary Treatment Information, Federal Register, Vol. 38, No. 159, August 17, 1973
- EPA Cost-Effectiveness Analysis Guidelines, Federal Register, Vol. 43, No. 188, September 27, 1978
- NPDES permit
- Nevada Water Pollution Control Law, NRS 485.375

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- Nonregulatory constraints relating to time of implementation, energy consumption, operational reliability, committed or approved facility construction and public concerns or opposition to a particular alternative.

Master Project Design Criteria

The alternatives proposed in the Facilities Plan must provide sufficient capacity to meet the needs for 20 years from initiation of project construction, regardless of whether the initial increment of construction is sufficient for the entire 20 years. However, at the start of the Facilities Planning process, the population projections, the per capita flow generation rate, and the estimated date of initiation of construction were all unknown. Although these factors were defined in detail as the Facilities Plan and EIS progressed, it was decided that no change would be made in the proposed design capacity of 40 mgd, which was recommended initially in the 1975 Draft Facilities Plan. This flow was calculated using a projected total equivalent population of 296,180 (including tourists) and a per capita flow of 135 gpcd. A second reason for using 40 mgd as a future design capacity is based upon sizing of existing clarifiers and aeration basins. The clarifiers have all been constructed with capacities of 6 2/3 mgd and the aeration basins with capacities of 10 mgd. The lowest common denominator of these two capacities is 40 mgd.

Water quality considerations also affect the future NPDES requirements, and therefore the types of treatment processes which were evaluated by the Facilities Plan. At the start of the facilities planning process, a year-long study of the Truckee River water quality was conducted by PEL. PEL (1979) recommended that certain water quality objectives be maintained, using a combination of advanced wastewater treatment and a minimum of 1:1 dilution of effluent with river water. These recommended water quality objectives were then used as the basis for future effluent standards for the proposed facilities, and will probably be used as the basis for the future NPDES permit which the Master Project will be designed to meet.

Alternative Concepts Initially Studied

Effluent Discharge Limitations

A wide variety of land application and Truckee River discharge concepts were developed in the facilities planning effort, and these alternatives are presented and discussed in the Draft Facilities Plan (Kennedy/Jenks Engineers, 1980).

The effluent discharge criteria which were used for the initial screening of alternatives are presented in Table 3-1.

To simplify the procedure of screening alternatives on the basis of cost, the various alternatives under consideration were divided into the following categories:

- Secondary treatment concepts common to all alternatives
- Advanced wastewater treatment alternatives for Truckee River discharge
- Land application alternatives

Each of these concepts is described in the following sections.

Secondary Treatment Concepts Common to All Alternatives

All alternatives require certain additions to the existing treatment facilities and Early Start Project facilities, regardless of whether only secondary treatment is provided or if secondary plus advanced treatment is required. The additions common to essentially all of the alternatives include:

- Increasing influent pumping to 40 mgd (average), 60 mgd (peak), with 20 mgd standby
- Primary and secondary sedimentation tanks (one of each)
- A phosphorus stripping tank
- An anaerobic digester
- Office and laboratory facilities, and electrical substation improvements
- New outfall and diffusers to Truckee River (river discharge alternatives only)

Advanced Wastewater Treatment Alternatives for Truckee River Discharge

Fifteen treatment concepts were evaluated for AWT treatment prior to discharge to the Truckee River. Fourteen of these were developed and analyzed in this initial screening, and the fifteenth was developed during the detailed analysis of alternatives. Some of these concepts require effluent filtration, which would be accomplished by gravity filtration. Gravity filtration was selected over either microscreens or pressure filtration in a separate cost-effectiveness analysis.

Table 3-1. Effluent Discharge Limitations Used in the Initial Screening Analysis

	Average	Daily Maximum
Flow	40 mgd	60 mgd
BOD		10 mg/1
SS		10 mg/1
Fecal Coliform	200/100 ml	2000/100 ml
Chlorine Residual		0.01 mg/1
Phosphorus (P)	0.35 mg/1	0.4 mg/1
Total Nitrogen (N)	5.0 mg/1	6.0 mg/1
Ammonia (N)	0.5 mg/1	1.5 mg/1
Unionized Ammonia (N)	0.03 mg/1	0.10 mg/1
Nitrite (N)	0.1 mg/1	0.2 mg/1
Nitrate (N)	4.0 mg/1	10.0 mg/1

Note: Limitations for phosphorus and nitrogen species do not apply to alternatives which use land application throughout the year. Truckee Canal diversion alternatives must meet all limitations all year long.

SOURCE: Kennedy/Jenks, 1980.

The total capital costs, annual O&M costs, and total present worth of costs of these alternatives, as well as the constituents which each alternative removes, are shown in Table 3-2. The costs shown include the cost for effluent filtration where it is necessary, the cost of sludge disposal, and the cost of the basic treatment plant expansion to 40 mgd.

Land Application Alternatives

Sixteen different alternatives were developed for land application. Generally, these alternatives require secondary treatment only, although some require filtration and phosphorus removal for a portion of the year (Table 3-3).

Feasibility and Economic Screening of Alternatives

To reduce the 31 alternatives to a manageable number, both economic screening and technical feasibility screening were utilized. Six alternatives were eliminated because they appeared to be technically infeasible. Using the costs presented in Tables 3-2 and 3-3 as a basis, 17 additional treatment and disposal alternatives were screened out.

Description of Master Project Alternatives Selected for Detailed Analysis

From the variety of alternatives which were presented in the previous section, nine were selected for more detailed evaluation. Six of these nine alternatives use the Truckee River for effluent disposal, two of the remaining nine alternatives use land application for effluent disposal, and the ninth alternative uses the Truckee Canal for effluent discharge. The nine alternatives which were selected for detailed evaluation are:

Advanced Wastewater Treatment Alternatives - Truckee River Discharge

T-5 - Fluidized Bed Nitrification/Denitrification
T-6a - Modified PhoStrip Nitrification/Denitrification
T-9 - Selective Ion Exchange
T-12 - Trickling Filter Nitrification/Denitrification
T-14a - Modified PhoStrip Nitrification/Denitrification With Supplemental Denitrification for Polishing
T-15 - Trickling Filter Nitrification/Fluidized Bed Denitrification

Table 3-2

INITIAL SCREENING COSTS OF ADVANCED WASTE TREATMENT ALTERNATIVES[1,2]

Alternative	Nutrients Removed		Total Capital Cost - $	Annual O&M Cost - $/Yr	Total Present Worth[3]- $
	Nitrogen	Phosphorus			
T-1 Air Stripping of Ammonia	X	X	COSTS NOT DEVELOPED		
T-2 Algae Stripping	X	X	COSTS NOT DEVELOPED		
T-3 Bardenpho Process	X	X	44.91	1.525	57.66
T-4 Breakpoint Chlorination	X	X	15.35	2.645	43.21
T-5 Fluidized Bed Nitrification/ Denitrification	X	X	24.88	1.725	41.62
T-6 Modified Pho-Strip Nitrification/Denitrification	X	X	27.42	0.655	32.23
T-7 Rotating Biological Contactor Nitrification/ Denitrification	X	X	37.31	1.585	51.34
T-8 Reverse Osmosis	X	X	40.69	6.357	108.88
T-9 Selective Ion Exchange	X	X	24.82	1.945	44.95
T-10 Submerged Filter Nitrification/Denitrification	X	X	53.68	2.81	79.63
T-11 Two Stage Activated Sludge Nitrification/ Denitrification	X	X	37.93	2.145	58.01
T-12 Trickling Filter Nitrification/Denitrification	X	X	25.65	1.665	43.13
T-13 Activated Sludge Nitrification/Submerged Filter Denitrification	X	X	35.18	2.48	59.24
T-14 Modified Pho-Strip Nitrification/Denitrification With Supplemental Denitrification for Polishing	X	X	29.44	0.975	37.56

[1] Costs are in millions of dollars.
[2] Costs include sludge disposal.
[3] Calculated using 6 5/8 percent and 20-year life.

SOURCE: Kennedy Engineers, 1979.

Table 3-3

INITIAL SCREENING COSTS OF LAND APPLICATION ALTERNATIVES[1]

Alternative	Treatment Required		Initial Cost $	Annual Operational Cost - $/yr	Total Present Worth[3] - $
	Phosphorus Removal	Filtration			
L-1 Truckee Canal Diversion	X	X	29.03	1.617	33.09
L-2 Truckee Canal Diversion - Fernley Drain Option	X (5 mo/yr)	X (5 mo/yr)	43.50	0.463	43.68
L-3 Dodge Flat Irrigation With Storage			COSTS NOT DEVELOPED		
L-4 Dodge Flat Irrigation Without Storage			COSTS NOT DEVELOPED		
L-5 Dodge Flat Irrigation/Truckee Canal Diversion	X (7 mo/yr)	X (7 mo/yr)	50.31	-0.065	44.88
L-6 Dodge Flat Irrigation and Rapid Infiltration			45.83	-0.266	38.83
L-7 Dodge Flat Irrigation/ Fernley Drain Option			48.45	-0.369	39.87
L-8 Dodge Flat/Wadsworth Irrigation With Storage			59.86	-0.566	48.20
L-9 Dodge Flat/Wadsworth Irrigation and Rapid Infiltration			49.14	-0.294	41.47
L-10 Spanish Springs Irrigation and Rapid Infiltration			50.11	-0.064	42.36
L-11 Spanish Springs Forest Irrigation with Storage			57.28	1.03	62.13
L-12 Spanish Springs Rapid Infiltration/Warm Springs Irrigation Option			55.80	1.296	51.80
L-13 Washoe Lake Artificial Wetlands and Rapid Infiltration			33.60	4.031	50.46
L-14 Huffaker Hills Area Artificial Wetlands and Rapid Infiltration			DELETED DUE TO PENDING URBAN DEVELOPMENT AND POTENTIAL GROUNDWATER DEGRADATION		
L-15 Long Valley Creek Artificial Wetlands and Rapid Infiltration			DELETED DUE TO LOW SOIL PERMEABILITY AND PRESENT LANDFILL OPERATION IN PROPOSED AREA		
L-16 Dodge Flat/Fernley-Swingle Bench Irrigation With Storage	X (7 mo/yr)	X (7 mo/yr)	79.04	0.023	70.94
L-17 Dodge Flat Irrigation With High Level Storage[2]			80.46	1.439	88.97

[1] Costs are in millions of dollars, and include the cost of sludge disposal.
[2] Source: Cooper & Associates, 1980a.
[3] Calculated using 6 5/8 percent and 20-year life.

SOURCE: Kennedy Engineers, 1979.

Land Application Alternatives

L-6 - Dodge Flat Irrigation with Rapid Infiltration
L-7 - Dodge Flat Irrigation/Fernley Drain Option

Truckee Canal Discharge

L-1 - Truckee Canal Diversion to Lahontan Reservoir

Effluent Discharge Limitations Used in the Detailed Screening Analysis

When the initial screening of the various alternatives was conducted, effluent discharge limitations presented in Table 3-1 were used as the basis for the required level of treatment. As the project progressed, however, additional information became available, and more specific discharge limitations were established for both the Truckee River discharge alternatives and for the land application alternatives. These more specific effluent limitations which were used in the detailed screening of alternatives are shown in Table 3-4.

The values shown in Table 3-4 for Truckee River discharge are based upon limitations presented in the PEL report, *Effects of the Reno-Sparks Joint Water Pollution Control Plant on Water Quality of the Truckee River*. These limitations are based upon being able to achieve a 1:1 dilution at minimum river flows.

Alternative T-5 - Fluidized Bed Nitrification/Denitrification - Truckee River Discharge

Concept of Operation. Wastewater treatment would consist of secondary treatment with PhoStrip phosphorus removal, fluidized bed nitrification/denitrification, gravity filtration, chlorination and dechlorination using sulfur dioxide. Effluent discharge would be to the Truckee River at one of the locations which are discussed in a subsequent section of this chapter. A schematic diagram showing the treatment concepts which would be utilized is shown in Figure 3-1. Anaerobically digested sludge would be exported to Spanish Springs Valley for land disposal.

Facilities Required. The existing secondary facilities, the ESP PhoStrip facilities, and the existing chlorination/dechlorination facilities would all be expanded from 30 mgd to a new capacity of 40 mgd. New facilities which would be constructed include the fluidized bed nitrification/denitrification reactors and gravity filtration facilities, all of which would be constructed with a capacity of 40 mgd. Side-stream flow equalization would be added prior to nitrification.

Table 3-4. Effluent Discharge Limitations Used in the Detailed Screening Analysis

	Truckee River Discharge Alternatives[1] (T-5, T-6a, T-9, T-12, T-14a T-15)	Land Application Alternatives[2]	
		Truckee Canal Diversion (L-1)	Dodge Flat (L-6, L-7)
BOD (5-day, 20°C) - mg/l	8	4	7
Suspended Solids - mg/l	8	<5	14
Chlorine Residual - mg/l	0.01	-	-
Total Phosphorus (P) - mg/l	0.6	0.4	6.0
Total Nitrogen (N) - mg/l	6.0	21.5	21.5
Ammonia Nitrogen (N) - mg/l	0.5	16	16
Nitrate Nitrogen (N) - mg/l	4	1.0	1.0
Nitrite Nitrogen (N) - mg/l	0.1	1.5	1.5
Unionized Nitrogen (N) - mg/l	0.03	-	-
Total Organic Nitrogen (N) - mg/l	-	3.0	3.0
Total Dissolved Solids - mg/l	500	350	350
pH Range	6.5-8.0	6.5-8.0	6.5-8.0

[1] Values shown are daily averages computed from a minimum of four sample values at 6-hour intervals.

[2] Values are annual means.

Facilities which are required for sludge export to Spanish Springs Valley are described in a subsequent section of this chapter.

Cost of Facility Construction and Operation. The capital cost of Alternative T-5 is estimated to be $35,000,000 and the annual operation and maintenance costs are estimated at $2,380,000 per year. These costs include the cost of sludge treatment and disposal.

Feasibility and Reliability. Both the nitrification and denitrification processes are biologically reliable, as long as proper environmental conditions are maintained. Environmental conditions of importance include a high enough temperature, oxygen in the nitrification reactor, anaerobic conditions and sufficient quantities of an external carbon source such as methanol in the denitrification reactor and proper fluidization of the sand beds. The most significant problems which may be encountered include poor distribution of flow across the cross-section of the sand beds, oxygen distribution problems throughout the bed of the nitrification reactor, and the inability to maintain the beds in a properly fluidized condition throughout the daily diurnal flow variation which will occur.

Pilot scale testing of this process is presently being conducted at the JWPCP but results to date have been inconclusive. Pilot plant results are continuing in an attempt to obtain more conclusive results.

Ability to Meet Effluent Quality Standards. The combined nitrification/denitrification process is, in theory, capable of removing in excess of 90 percent of the nitrogen in wastewater. Removals as high as 99 percent would allow the effluent discharge limitations presented in Table 3-4 to be successfully met.

Pilot scale testing of the fluidized bed denitrification process is presently underway, and the results to date have been discouraging. On the basis of this pilot testing, fluidized bed nitrification/denitrification does not appear to be a reliable process for meeting nitrogen limitations. Breakpoint chlorination is included in the facilities required and, if the process is close to meeting the discharge limitations, could be used for additional nitrogen removal.

Alternative T-6a - Modified PhoStrip Nitrification/Denitrification - Truckee River Discharge

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Concept of Operation. Wastewater treatment would be provided secondary treatment with PhoStrip for phosphorus removal, and activated biological filtration for nitrification, an anaerobic reactor for denitrification, gravity filtration, chlorination, and dechlorination using sulfur dioxide. Possible locations for the outfall would be the same as Alternative T-5. A schematic flow diagram of the required facilities is presented in Figure 3-2.

Facilities Required. Existing secondary facilities, ESP PhoStrip facilities and chlorination facilities would be expanded from their present capacity to a new capacity of 40 mgd. All of the new facilities which are shown in Figure 3-2 would be constructed with an initial capacity of 40 mgd. Side-stream flow equalization would be used prior to filtration. An outfall to the Truckee River would be required, and possible locations for the outfall are discussed in a subsequent section. Sludge handling facilities required for conveyance of sludge to Spanish Springs Valley are discussed in a subsequent portion of this chapter.

Cost of Facility Construction and Operation. The estimated initial cost of expanding existing facilities and constructing new facilities is $35,690,000, and the annual cost is estimated to be $1,030,000 per year. These costs include the cost of sludge treatment and disposal.

Feasibility and Reliability. The processes used in Alternative T-6 are feasible and will result in the removal of both nitrogen and phosphorus. The ability of the process to produce high levels of nitrogen removal in the denitrification stage is doubtful, since no external carbon source would be utilized. Without an external carbon source, the denitrification process will be slower, less stable, and probably result in a lower degree of denitrification than systems using an external carbon source. The probable maximum nitrogen removal is estimated to be 70 percent unless the breakpoint chlorination facilities are used for effluent polishing.

Ability to Meet Effluent Quality Standards. With the exception of nitrogen, the process as shown in Figure 3-2 should be capable of meeting the effluent discharge limitations presented in Table 3-4. It is doubtful, however, that the required nitrogen limits could be consistently met by this process.

Alternative T-9 - Selective Ion Exchange - Truckee River Discharge

Concept of Operation. Wastewater treatment would be secondary treatment with PhoStrip phosphorus removal, gravity filtration, ion exchange ammonia removal, chlorination, and dechlorination with sulfur dioxide. The outfall to the Truckee River would be the same as Alternative T-5. Figure 3-3 presents a schematic diagram of the required treatment processes.

FIGURE 3-2

ALTERNATIVE T-6a

TREATMENT SCHEMATIC FOR
MODIFIED PHOSTRIP NITRIFICATION / DENITRIFICATION

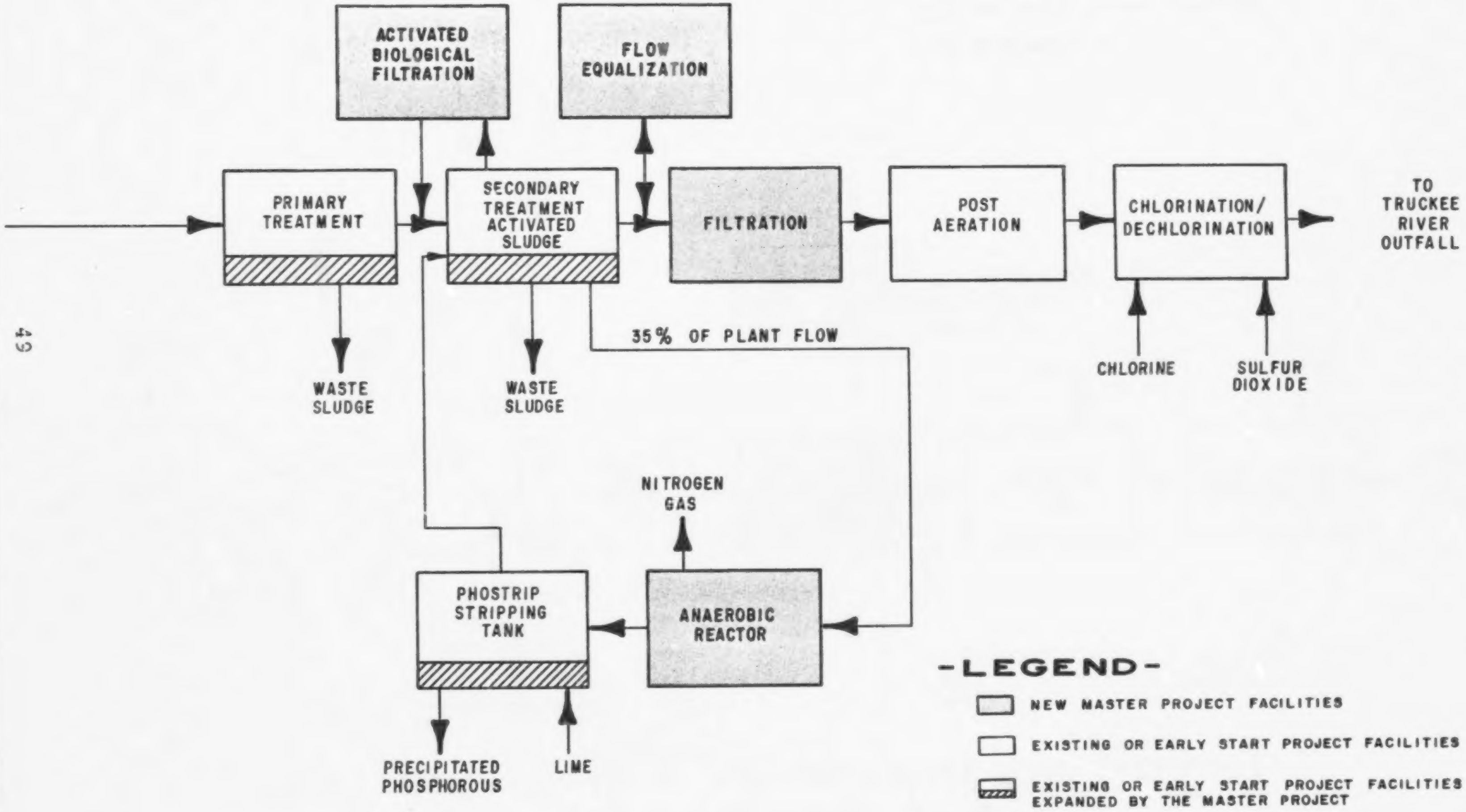
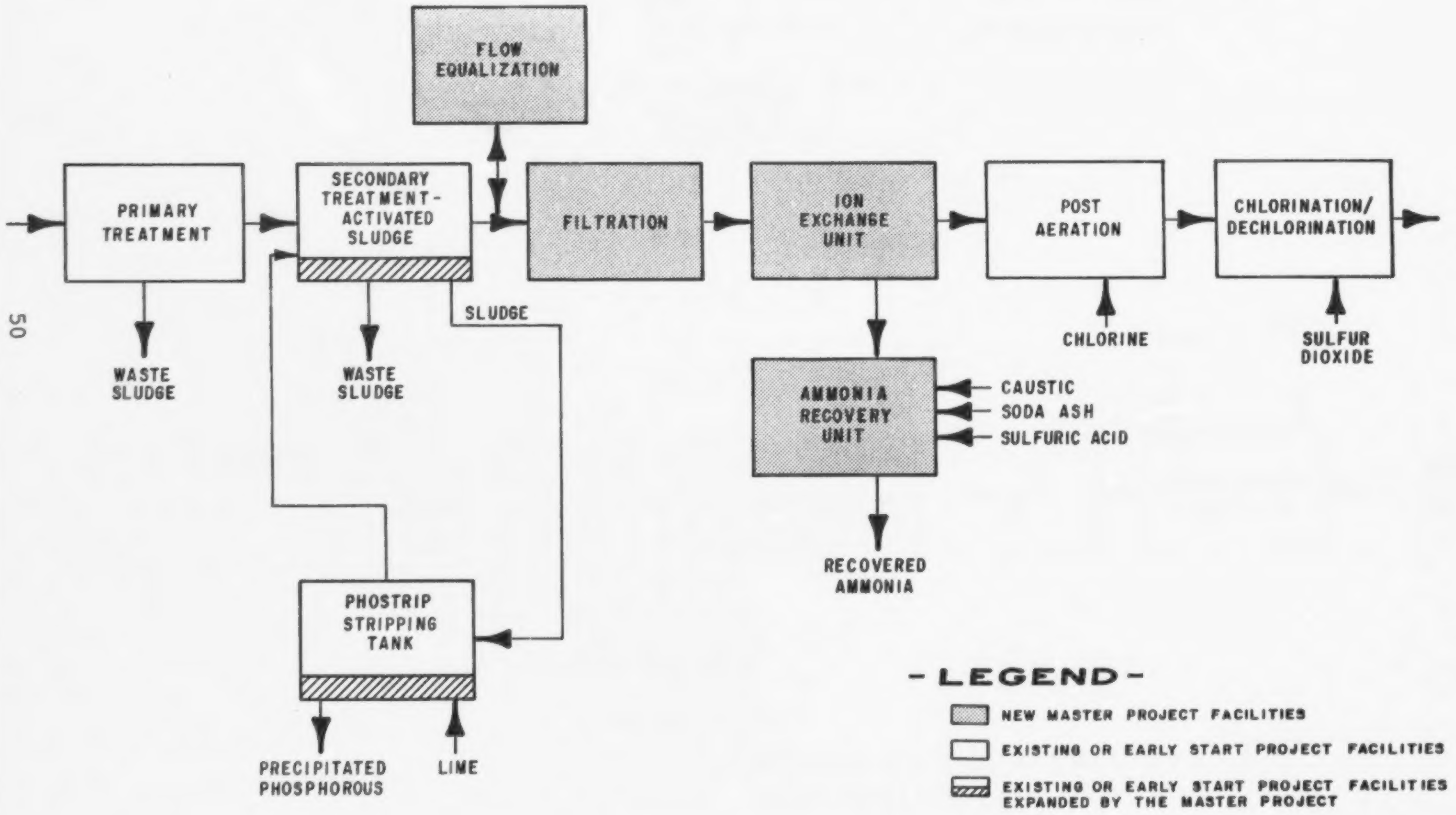

ACTIVATED BIOLOGICAL FILTRATION
FLOW EQUALIZATION
PRIMARY TREATMENT
SECONDARY TREATMENT ACTIVATED SLUDGE
FILTRATION
POST AERATION
CHLORINATION/ DECHLORINATION
TO TRUCKEE RIVER OUTFALL
WASTE SLUDGE
WASTE SLUDGE
35% OF PLANT FLOW
CHLORINE
SULFUR DIOXIDE
NITROGEN GAS
PHOSTRIP STRIPPING TANK
ANAEROBIC REACTOR
PRECIPITATED PHOSPHOROUS
LIME
-LEGEND-
NEW MASTER PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES EXPANDED BY THE MASTER PROJECT

FIGURE 3-3

ALTERNATIVE T-9

TREATMENT SCHEMATIC FOR SELECTIVE ION EXCHANGE



Facilities Required. Existing secondary treatment, PhoStrip and chlorination facilities would be expanded from their present capacity to a capacity of 40 mgd. The new filtration, ion exchange and dechlorination facilities would be constructed with an initial capacity of 40 mgd. Required sludge handling facilities are discussed in a subsequent section of this chapter.

Cost of Facility Construction and Operation. An estimate of $44,370,000 has been made for the initial capital cost and $2,630,000 for the annual operating cost. It is possible that all of the wastewater will not have to be treated by ion exchange, and blending could then be used to reduce the annual operation and maintenance cost. These costs include the cost of sludge treatment and disposal.

Feasibility and Reliability. The processes required for this alternative have a high degree of feasibility and reliability, since they are primarily chemical in nature rather than biological. This greater reliability stems from the ability of chemical processes to be more closely controlled and therefore more adaptable to the treatment of diurnal flow fluctuations.

Ability to Meet Effluent Quality Standards. Alternative L-9 should have no difficulty meeting effluent quality limitations.

Alternative T-12 - Trickling Filter Nitrification/Denitrification

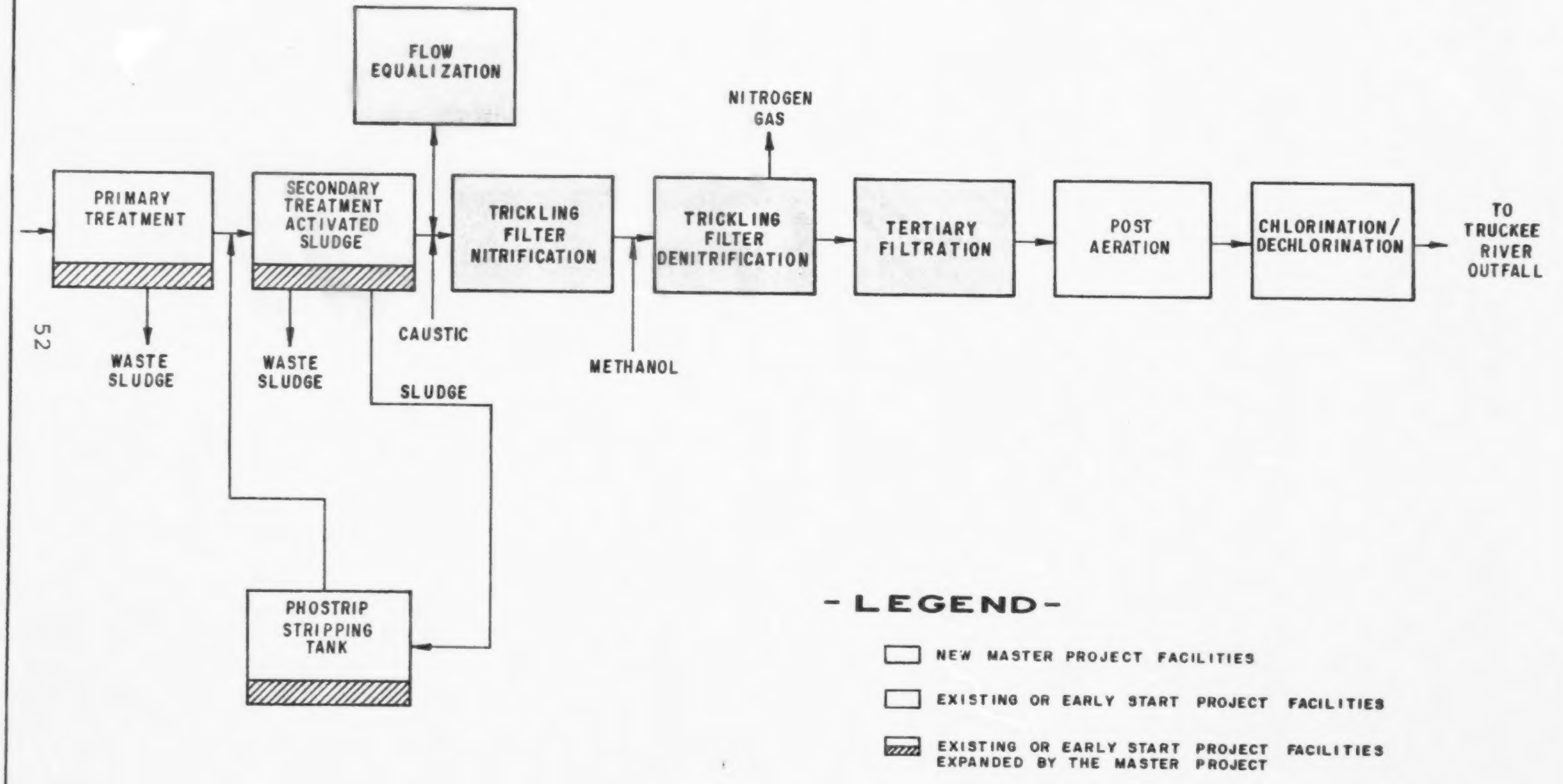
Concept of Operation. Existing activated sludge and PhoStrip facilities would be used for secondary treatment and phosphorus removal. A conventional trickling filter and a trickling filter enclosed in an anaerobic reactor would be used for nitrification and denitrification, respectively. Effluent disposal would be to the Truckee River, as discussed in a subsequent section. A schematic flow diagram is presented in Figure 3-4.

Facilities Required. Existing primary and secondary facilities, PhoStrip facilities, and chlorination/dechlorination facilities would be expanded from 30 mgd to 40 mgd. Entirely new facilities with a capacity of 40 mgd would be constructed for nitrification, denitrification, and filtration. Side-stream flow equalization facilities would also be constructed to equalize the flow prior to the nitrification stage. Facilities required for transport of sludge to Spanish Springs Valley are discussed in a subsequent section of this chapter.

FIGURE 3-4

ALTERNATIVE T-12

TREATMENT SCHEMATIC FOR TRICKLING FILTER NITRIFICATION/DENITRIFICATION


FLOW EQUALIZATION
NITROGEN GAS
PRIMARY TREATMENT
SECONDARY TREATMENT ACTIVATED SLUDGE
TRICKLING FILTER NITRIFICATION
TRICKLING FILTER DENITRIFICATION
TERTIARY FILTRATION
POST AERATION
CHLORINATION/ DECHLORINATION
TO TRUCKEE RIVER OUTFALL
CAUSTIC
WASTE SLUDGE
WASTE SLUDGE
METHANOL
SLUDGE
PHOSTRIP STRIPPING TANK
- LEGEND -
NEW MASTER PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES EXPANDED BY THE MASTER PROJECT

Cost of Facility Construction and Operation. Alternative T-12 has an estimated initial capital cost of $36,350,000 and an annual operation and maintenance cost of $2,280,000. These costs include the cost of sludge treatment and disposal.

Feasibility and Reliability. The trickling filter process which is to be used for nitrification is a well proven process, and there should be no unexpected operational problems. The covered trickling filters to be used for denitrification have not been used on a full-scale basis, although from a biological standpoint, the process is proven. PhoStrip facilities to be used for phosphorus removal have been successfully tested at the JWPCP.

Ability to Meet Effluent Quality Standards. Nitrogen removal by nitrification/denitrification should exceed 95 percent and no problems should be encountered in meeting nitrogen limitations. Breakpoint chlorination could be used for any subsequently required effluent polishing of ammonia and the gravity filters should be capable of reducing effluent suspended solids to less than 8 mg/l.

Alternative T-14a - Modified PhoStrip Nitrification/Denitrification With Supplemental Denitrification for Polishing - Truckee River Discharge

Concept of Operation. Alternative T-14a is a combination of Alternatives T-6a and T-5. Nitrification would be provided by an activated biological filter (as in T-6a) and denitrification would be provided in a subsequent fluidized bed denitrification reactor (as in T-5). Phosphorus would be removed by PhoStrip and side-stream flow equalization would be used prior to denitrification. A schematic showing the arrangement of the required process is shown in Figure 3-5.

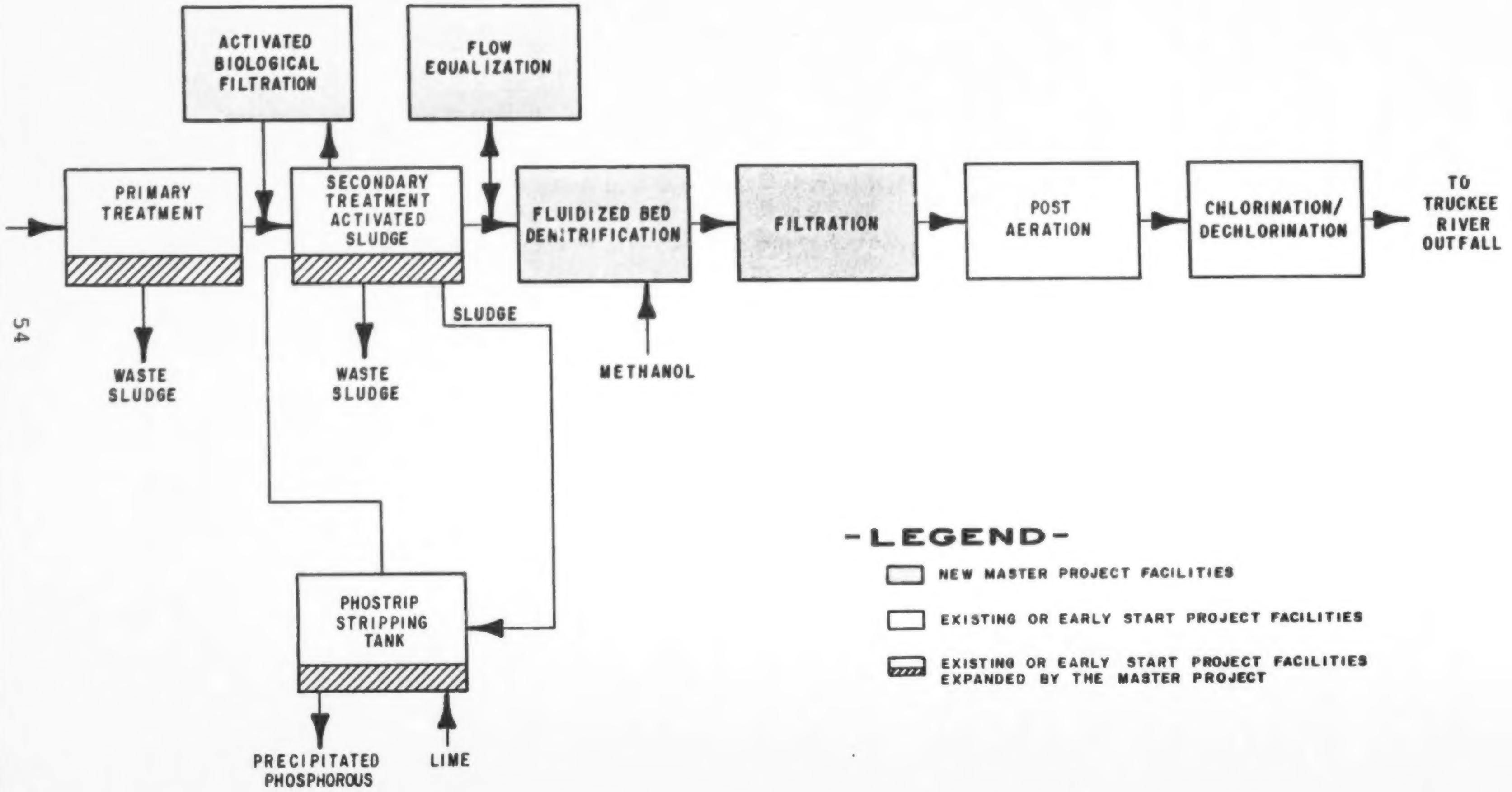
Facilities Required. Existing secondary treatment, ESP PhoStrip and chlorination/dechlorination facilities would be expanded from 30 mgd to 40 mgd. New facilities would include the addition of activated biological filters for nitrification, fluidized bed denitrification reactors, and filtration facilities, and flow equalization. All of the new facilities would be constructed with a capacity of 40 mgd. The outfall requirements and possible locations are discussed in a subsequent section. Required sludge handling facilities are discussed in a subsequent section of this chapter.

Cost of Facility Construction and Operation. Initial capital costs are estimated to be $38,090,000, with an estimated annual operation and maintenance cost of $1,420,000. These costs include the cost of sludge treatment and disposal.

FIGURE 3-5

ALTERNATIVE T-14a

TREATMENT SCHEMATIC FOR MODIFIED PHOSTRIP WITH DENITRIFICATION POLISHING


ACTIVATED BIOLOGICAL FILTRATION
FLOW EQUALIZATION
PRIMARY TREATMENT
SECONDARY TREATMENT ACTIVATED SLUDGE
FLUIDIZED BED DENITRIFICATION
FILTRATION
POST AERATION
CHLORINATION/ DECHLORINATION
TO TRUCKEE RIVER OUTFALL
WASTE SLUDGE
WASTE SLUDGE
SLUDGE
METHANOL
PHOSTRIP STRIPPING TANK
PRECIPITATED PHOSPHOROUS
LIME
-LEGEND-
NEW MASTER PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES EXPANDED BY THE MASTER PROJECT

Feasibility and Reliability. Alternative T-14a is feasible treatment technique which has a higher overall reliability than either Alternatives T-5 or T-6. Although its reliability would probably be higher than either T-5 or T-6, its overall reliability is not as high as the ion exchange Alternative T-9. The component treatment process which appears to have the lowest feasibility from a full-scale operational standpoint is the fluidized bed denitrification reactor, for the reasons previously discussed under Alternative T-5.

Ability to Meet Effluent Quality Standards. Nitrogen removals exceeding 99 percent should be achievable, and the discharge limitations presented in Table 3-4 are achievable. Pilot scale testing of the fluidized bed denitrification process is presently underway, and the capabilities of this process will be more completely known at the completion of this testing.

Alternative T-15 - Trickling Filter Nitrification/Fluidized Bed Denitrification

Concept of Operation. From the standpoint of nitrogen removal, this alternative is a combination of the trickling filter nitrification concept used in Alternative T-12, and the fluidized bed concept used for denitrification in Alternative T-5. Phosphorus removal would be by the PhoStrip facilities constructed in the ESP, and remaining facilities would be identical to Alternative T-5. A schematic flow diagram of the proposed treatment process is shown in Figure 3-6.

Facilities Required. With the exception of the nitrification/denitrification facilities, all facilities are identical to Alternative T-5. The trickling filter nitrification facilities and the fluidized bed denitrification facilities, which are the same as those in Alternatives T-12 and T-5, respectively, would both be constructed to a capacity of 40 mgd. Required sludge handling facilities are discussed in a subsequent section of this chapter.

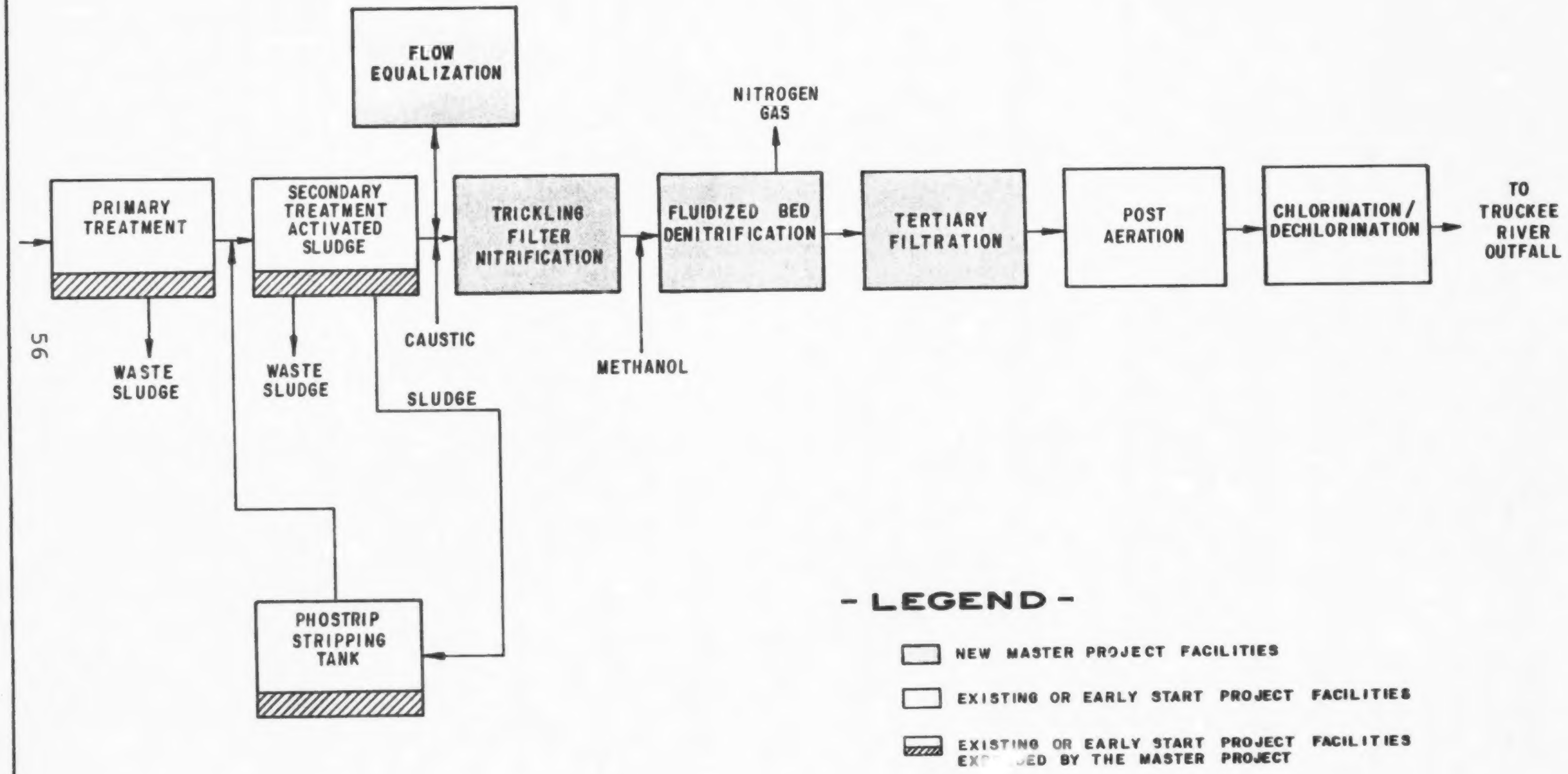
Cost of Facility Construction and Operation. Capital costs are estimated to be $33,310,000 and annual operation and maintenance costs are estimated to be $2,250,000. These costs include sludge treatment and disposal.

Feasibility and Reliability. With the exception of the fluidized bed denitrification processes, the overall treatment scheme appears to be both feasible and reliable. Fluidized bed denitrification is presently not a proven process, and its long-term reliability is questionable.

FIGURE 3-6

ALTERNATIVE T-15

TREATMENT SCHEMATIC FOR TRICKLING FILTER NITRIFICATION/FLUIDIZED BED DENITRIFICATION


FLOW EQUALIZATION
NITROGEN GAS
PRIMARY TREATMENT
SECONDARY TREATMENT ACTIVATED SLUDGE
TRICKLING FILTER NITRIFICATION
FLUIDIZED BED DENITRIFICATION
TERTIARY FILTRATION
POST AERATION
CHLORINATION/ DECHLORINATION
TO TRUCKEE RIVER OUTFALL
WASTE SLUDGE
WASTE SLUDGE
CAUSTIC
METHANOL
SLUDGE
PHOSTRIP STRIPPING TANK
- LEGEND -
NEW MASTER PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES EXPANDED BY THE MASTER PROJECT

Ability to Meet Effluent Quality Standards. If the denitrification process operates reliably, effluent limitations would be met. If not, it is probable that nitrate limitations would be exceeded.

Alternative L-1 - Truckee Canal Diversions, Land Application

Concept of Operation. Wastewater treatment would consist of secondary treatment, phosphorus removal by the PhoStrip process, and gravity filtration. A gravity pipeline would be constructed from the JWPCP to the Truckee Canal immediately below Derby Dam. In the canal, effluent would be mixed with diverted Truckee River water. At design capacity, the annual effluent diversions would be about 42,125 acre-feet. No new storage reservoirs would be required and all storage would be in Lahontan and Sheckley Reservoirs. All wastewater would be used for irrigation during summer months, and any wastewater not used during the winter months would mix with overflow from Lahontan Reservoir and be allowed to drain to the Stillwater WMA. A treatment schematic for this alternative is shown in Figure 3-7.

Design of Physical Facilities. Existing secondary treatment facilities, including the ESP, PhoStrip facilities, and chlorination/dechlorination facilities would be expanded to 40 mgd. Also, 40 mgd of new gravity filtration facilities would be constructed at the JWPCP. Side-stream flow equalization would be added prior to filtration. A gravity pipeline would be used to convey the filtered effluent to the Truckee Canal. For proper outfall operation, a 3.1-million-gallon surge tank would be constructed at the JWPCP. Outfall requirements and routing are discussed in the following section.

Cost of Facility Construction and Operation. The initial capital cost of the facilities is estimated to be $37,020,000 and the annual O&M cost would be $650,000 per year. Sludge treatment and disposal costs are included in the above costs.

Feasibility and Reliability. The alternative has a high degree of feasibility and reliability.

Ability to Meet Effluent Quality Standards. Effluent discharge limitations, which are presented in Table 3-4, should be met with no difficulty.

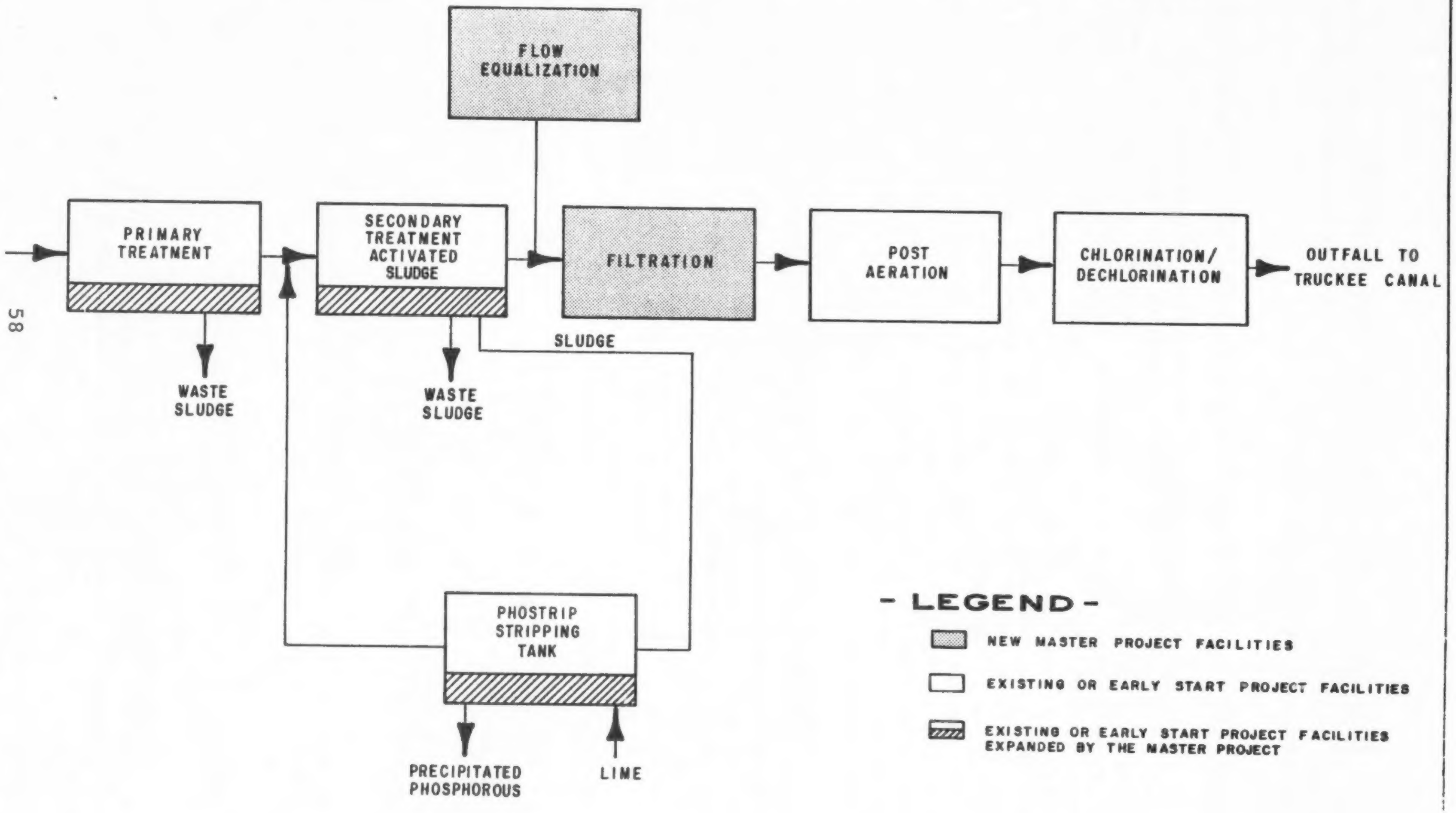
Alternative L-6 - Dodge Flat Irrigation with Winter Rapid Infiltration

Concept of Operation. Treatment would be secondary only, and PhoStrip facilities constructed in the ESP would no longer be used. Secondary facilities would be expanded

FIGURE 3-7

ALTERNATIVE L-1

TREATMENT SCHEMATIC FOR TRUCKEE CANAL DIVERSION


FLOW EQUALIZATION
PRIMARY TREATMENT
SECONDARY TREATMENT ACTIVATED SLUDGE
FILTRATION
POST AERATION
CHLORINATION/ DECHLORINATION
OUTFALL TO TRUCKEE CANAL
WASTE SLUDGE
WASTE SLUDGE
SLUDGE
PHOSTRIP STRIPPING TANK
PRECIPITATED PHOSPHOROUS
LIME
- LEGEND -
NEW MASTER PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES EXPANDED BY THE MASTER PROJECT

to 40 mgd and side-stream flow equalization facilities would be added after the chlorination/dechlorination facilities. A schematic diagram of the required treatment components is shown in Figure 3-8. A pipeline would carry the secondary effluent to Dodge Flat, where it would be used for agricultural irrigation during the summer months and for groundwater recharge during the winter months. Groundwater monitoring wells would be utilized. About 35,800 acre-feet per year of effluent would be available after storage losses with about 15,000 acre-feet per year being used for irrigation and 20,800 acre-feet per year being used for groundwater recharge.

Design and Physical Facilities. Secondary treatment facilities would be expanded to 40 mgd. A gravity pipeline would convey effluent to Dodge Flat, where a 48 mgd pumping station would pump it to a 1,000 acre-foot storage reservoir. During the summer irrigation months (May-October), 4,130 acres of land could be irrigated, and during the winter months, about 320 acres of land would be used to percolate effluent to the groundwater. The entire site at Dodge Flat would consist of 5,600 acres of land, and would be completely fenced. Six groundwater monitoring wells would be constructed. Typical elements of the irrigation system are identified on Figure 3-9. Outfall requirements and routing are discussed in a following section of this chapter.

Preliminary studies indicate that hay production would be the most attractive crop, with use of the hay as a cash crop or a combination of cash crop and beef operation.

Cost of Facility Construction and Operation. Based on Kennedy/Jenks Engineers' detailed analysis costs, the construction costs would be $63,760,000 and the annual O&M costs would be $640,000 per year. These costs include the cost of sludge treatment and disposal.

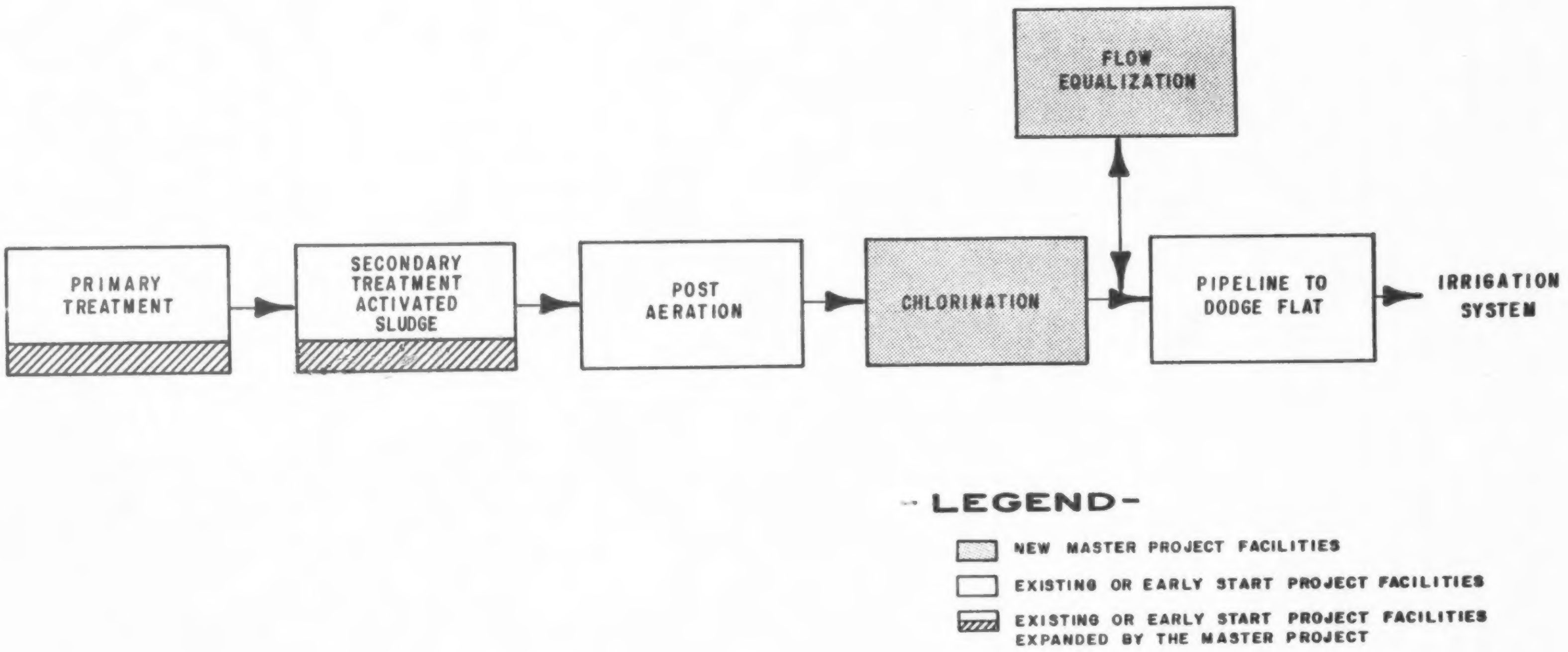
Feasibility and Reliability. Although technically feasible, overall feasibility depends upon obtaining about 18,000 acre-feet of water rights to replace water which would be disposed of by rapid infiltration during the winter months. An analysis of soils at Dodge Flat (Cooper & Associates, 1980) was conducted, and the soils appear to be well suited to the selected cropping practices, with only a small amount of the total area requiring gypsum addition to remove excess sodium. To prevent the return of soluble salts to the Truckee River as a result of the rapid infiltration during the winter months, a rapid infiltration area has been selected several miles to the west of the river. The area selected has extensive depths of granular deposits reaching to the water table.

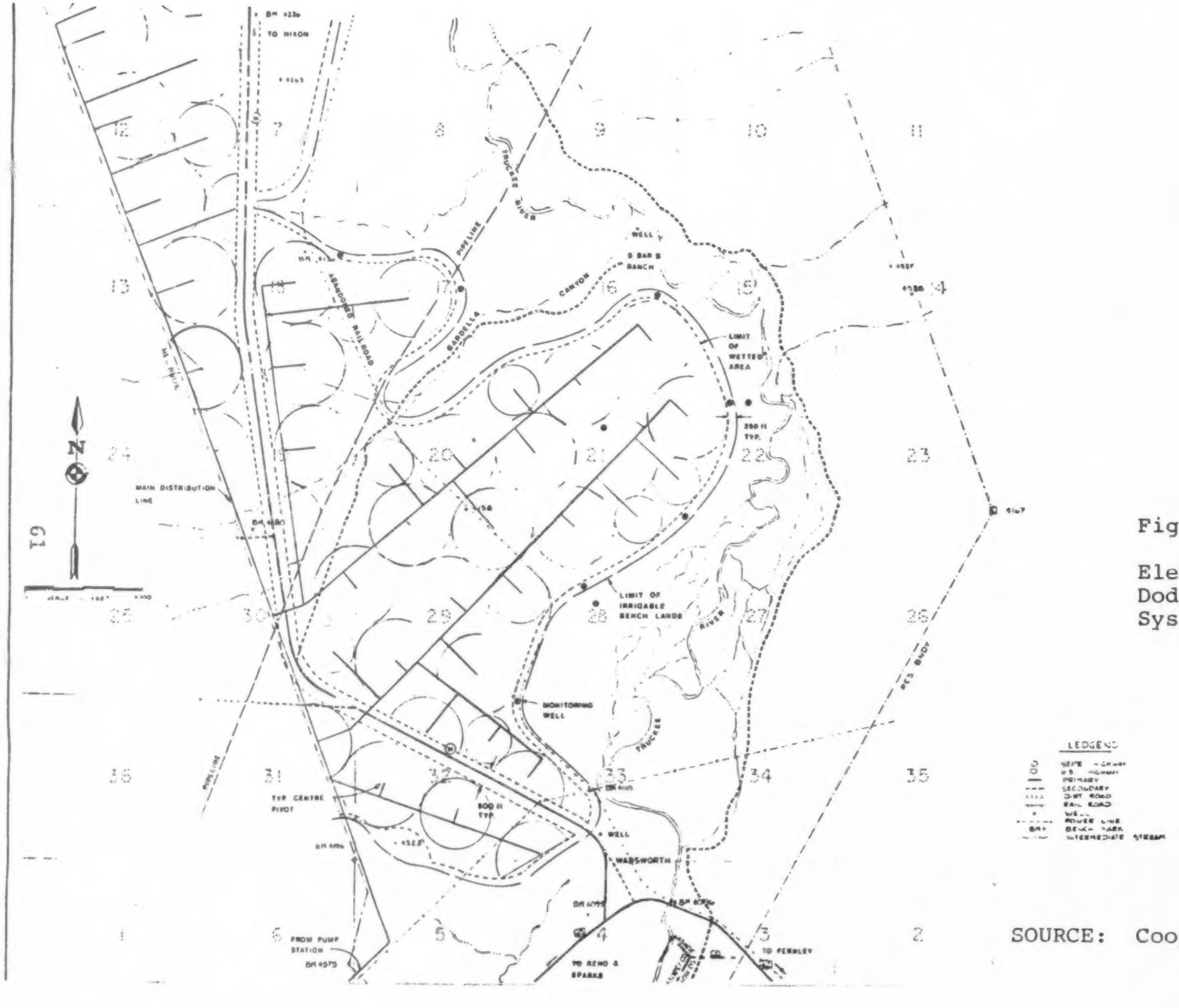
Ability to Meet Effluent Quality Standards. There should be no difficulty meeting the effluent quality limitations presented in Table 3-4.

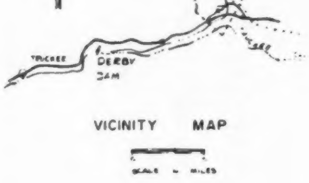
FIGURE 3-8

ALTERNATIVES L-6 & L-7

TREATMENT SCHEMATIC FOR DODGE FLAT IRRIGATION


PRIMARY TREATMENT
SECONDARY TREATMENT ACTIVATED SLUDGE
POST AERATION
CHLORINATION
FLOW EQUALIZATION
PIPELINE TO DODGE FLAT
IRRIGATION SYSTEM
- LEGEND -
NEW MASTER PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES
EXISTING OR EARLY START PROJECT FACILITIES EXPANDED BY THE MASTER PROJECT





VICINITY MAP

SCALE - MILES

Figure 3-9

Elements of the Proposed Dodge Flat Irrigation System

SOURCE: Cooper & Associates, 1980.

Alternative L-7 - Dodge Flat Irrigation/Fernley Drain Option

Concept of Operation. Secondary treatment would be provided at the JWPCP, and the ESP PhoStrip facilities would no longer be necessary. All effluent would be conveyed by gravity pipeline to the Dodge Flat area, where it would be utilized during the summer for irrigation. During the winter, it would be diverted through a new gravity pipeline to the Fernley drain. Twenty-one thousand, nine hundred acre-feet of this would be used for agricultural irrigation at Dodge Flat from May through October, and 20,275 acre-feet would be diverted to the Fernley drain during winter months. The schematic of required treatment processes is the same as for Alternative L-6, which is shown in Figure 3-8.

Design and Physical Facilities. Secondary treatment facilities would be identical to Alternative L-6. Gravity pipelines would be used for conveyance to Dodge Flat and to the Fernley Dam. A 48 mgd pumping station would be constructed near Dodge Flat to pump secondary effluent to a 1,000 acre-foot open storage reservoir, which would have about 67 acres of surface area. The irrigation area would require 4,130 acres, and would use center-pivot irrigation. The overall site requirements at Dodge Flat would be about 5,600 acres and the area would be completely fenced. Groundwater monitoring wells would be used at Dodge Flat. Typical elements of the irrigation system are identified on Figure 3-9. Outfall requirements and routing are discussed in the following section. Crop production would be the same as described under Alternative L-6.

Cost of Facility Construction and Operation. The detailed cost analysis presented in the draft Facilities Plan indicates an initial capital cost of $65,520,000 and an annual O&M cost of $350,000.

Feasibility and Reliability. Feasibility and reliability are similar to Alternative L-6, which is very high. As in Alternative L-6, water rights are a probable problem, with about 25,000 acre-feet of additional water rights being required to achieve implementation.

Ability to Meet Effluent Quality Standards. The effluent discharge limitations presented in Table 3-4 should be met with no difficulty.

Outfall Facilities

An outfall would be required from the JWPCP either to the Truckee River, to Dodge Flat, or to the Truckee Canal below Derby Dam. A description of the required facilities is contained in the following sections.

Outfall Facilities for Truckee River Discharge. A specific location for an outfall to the Truckee River has not been selected, although the PEL report described three favorable sites. These sites were selected on the basis of providing a mixing zone for the effluent and the river water, while maintaining a clear zone of passage for fish and aquatic organisms. Such a clear zone of passage does not presently exist because the discharge from Steamboat Creek flows completely across the Truckee River channel. The three favorable sites described by the PEL report are:

1. South bank of the Truckee River 75-100 feet below the confluence of Steamboat Creek. The discharge should be tangentially along the south bank of the river.

2. Downstream of the Vista Reef. This point is about 3 miles downstream of the JWPCP.

3. Below Mustang near the beginning of the gravel quarry area. This location is about 6 miles downstream of the JWPCP. Because the location is so far downstream, the PEL report recommended that a maximum of 1/3 to 1/2 of the planned 40 mgd discharge be at this location, with the remainder being at either 1 or 2 above, or a combination of both 1 and 2.

Outfall Facilities for Land Application and Truckee Canal Diversion Alternatives. The three land application alternatives which received detailed evaluation in the facilities plan, L-1, L-6, and L-7, each require an outfall easterly from the JWPCP, generally following the Truckee River. The same pipeline route would be used for each of these alternatives, although the pipeline route for L-1 is shorter than for L-6 and L-7, and the route used for L-6 is shorter than for L-7. The pipeline route is complicated not only by the hydraulic requirements, but also by right-of-way restrictions relating to I-80, the Southern Pacific Railroad, and private ownership. Numerous crossings of the Truckee River are also required, further complicating the routing. The following tables show the required number of crossings of I-80, the Truckee River, and the Southern Pacific Railroad, as well as the approximate length of the outfall, for each of the three land application alternatives.

Alternative	Truckee River Crossings	Southern Pacific Railroad Crossings	I-80 Crossings	Approximate Length of Outfall - feet
L-1	7	3	0	95,000
L-6	8	3	0	133,000
L-7	8	4	1	133,000

Generally speaking, the pipeline route above Derby Dam is the most complicated portion due to the numerous required river crossings. Below Derby Dam the pipeline route is simplified because for much of its length, if appropriate agreements are reached, it could be placed in the access road for the TCID canal. Figure 3-[illegible] presents a location map for the proposed pipeline route and a hydraulic profile for the pipeline which shows planned crossings of the Truckee River, the Southern Pacific Railroad, and I-80.

The pipeline will be buried for its entire length, generally to a depth of 4 feet, although shallower depths up to 2-1/2 feet will be allowed where necessary to maintain the pipeline grade or to avoid excessive cuts. Truckee River crossings will be made during the low flow summer months, when it is easiest to divert the river around the construction site. The pipeline would be constructed below the river bottom to protect it from scouring, and would be encased in concrete for additional protection. Crossings of the Southern Pacific and I-80 would be by jacking a casing beneath the right-of-way, and then inserting the outfall through this casing. Crossings of irrigation canals would be during periods of nonuse, and would be accomplished by trenching through the canal, and then reconstructing the canal to its original condition.

Sludge Handling and Disposal

Fourteen alternatives for sludge disposal were initially investigated and discussed in detail in _Expansion of Reno-Sparks JWPCP Early Start Sludge Program Facilities Plan Preliminary Draft_, November 1979 and Reno-Sparks _JWPCP Early Start Sludge Program Preliminary Draft Environmental Assessment_, January 1980. These alternatives included agricultural application of sludge, dewatering for hauling by truck to landfills, dedicated land disposal of liquid sludge, soil injection of liquid sludge, vermicomposting and facultative sludge lagoons. Based on cost and environmental factors, four of these alternatives were considered viable and subjected to detailed evaluation and an environmental assessment. The no-action alternative, which would be a continuation of existing disposal methods (i.e., subsurface injection of liquid sludge), was not considered to be a viable long-term alternative for sludge disposal. Following these detailed evaluations, Alternative S-12 was selected for sludge disposal: piping liquid sludge to Spanish Springs Valley for dedicated land disposal.

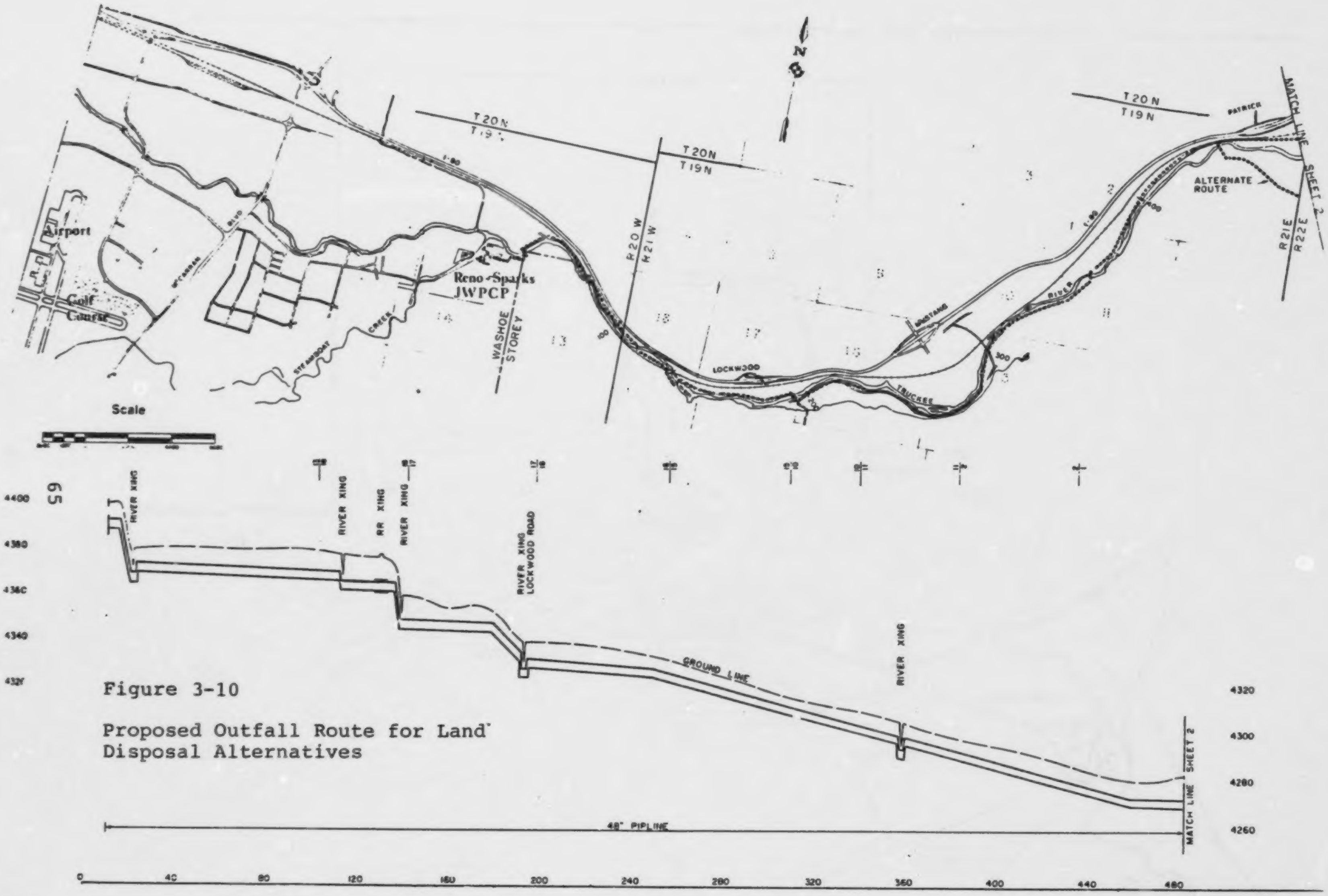
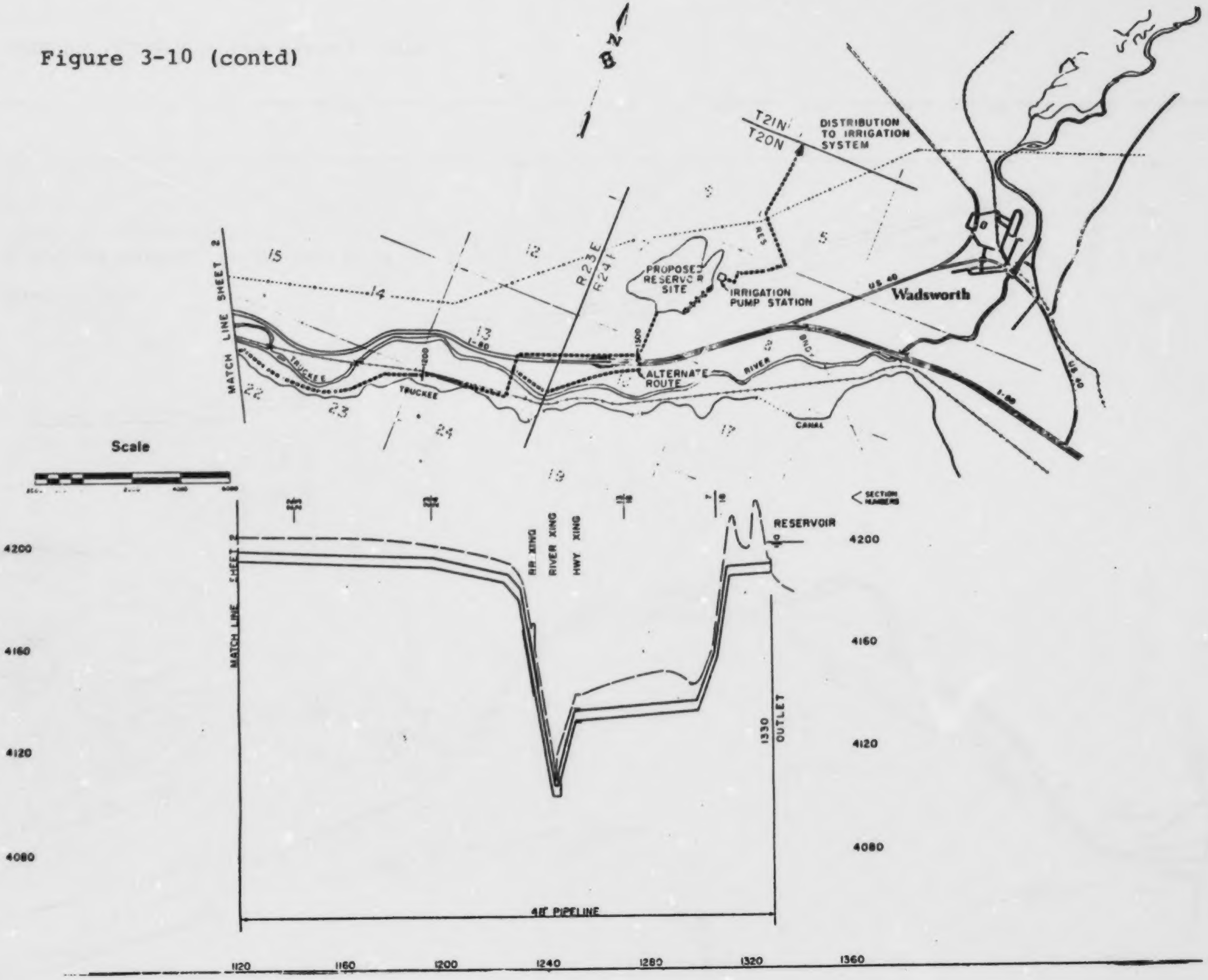


Figure 3-10

Proposed Outfall Route for Land Disposal Alternatives

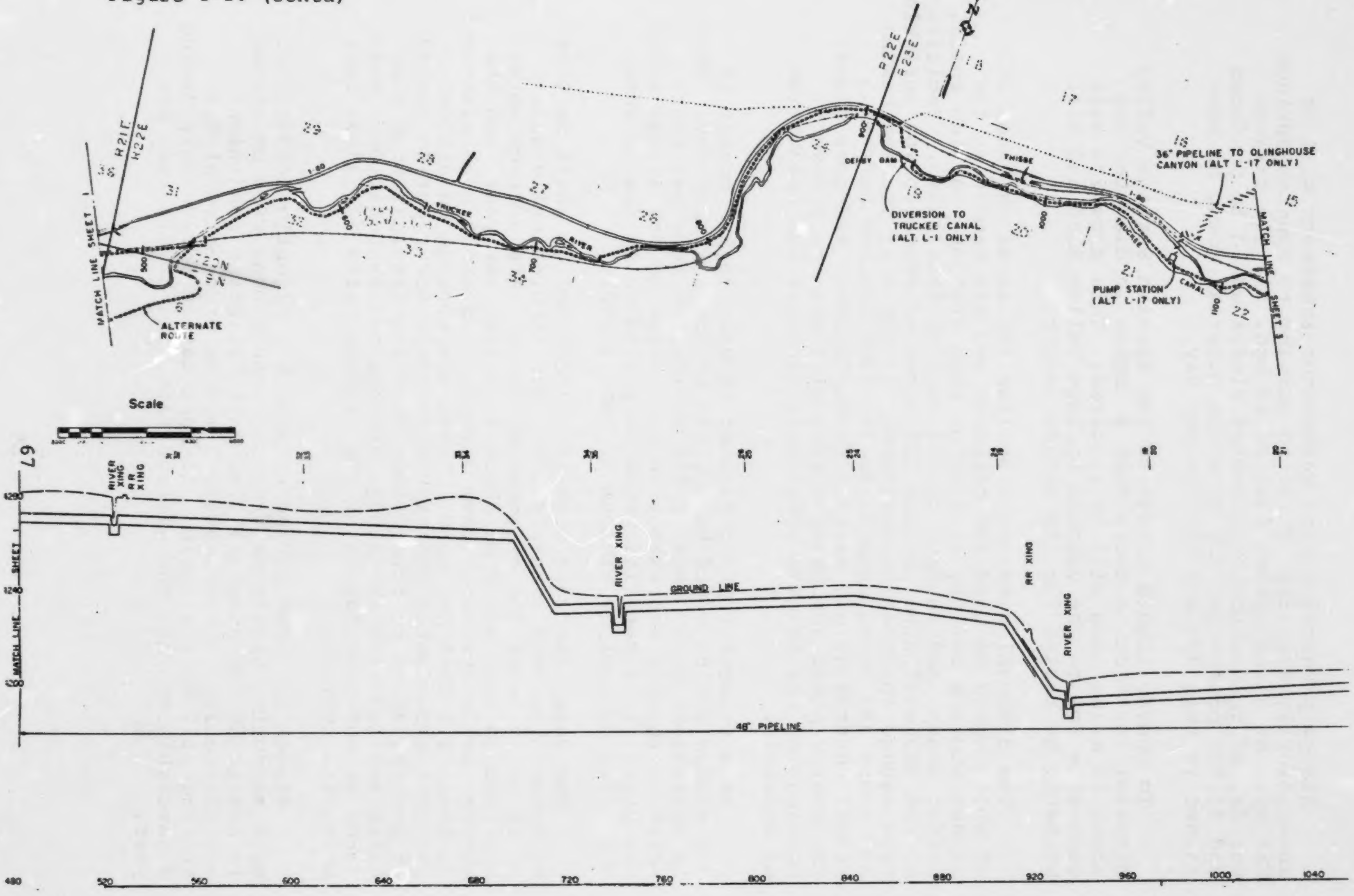
SOURCE: Cooper & Associates, 1980

Figure 3-10 (contd)



SOURCE: Cooper & Associates, 1980

Figure 3-10 (contd)



SOURCE: Cooper & Associates, 1980

Sludge produced during wastewater treatment will be anaerobically digested, prior to pumping to Spanish Springs Valley. At a wastewater flow of 40 mgd, 354,000 gallons per day of anaerobically digested sludge would be produced and 73,800 pounds per day of solid material would be contained in this 354,000 gallons per day.

To convey liquid sludge to the Spanish Springs Valley disposal location, a force main 8 inches in diameter and about 11 miles long will be required. This pipeline will generally follow the Spanish Springs Valley Road and will probably be buried for its entire length.

The disposal site would utilize 460 acres of land, 255 of which would be used for disposal and the remainder for sludge storage basins, irrigation pump station, service roads, buffer zones, and surface runoff control facilities. Facilities at the disposal site include 255 acres of center-pivot sprinkler type sludge application equipment, 14 acres of storage basins and about 191 acres devoted to 200-foot minimum buffering runoff control (e.g., earthen berm, ditches) and open space. The center pivot sprinkler system will use low pressure, nonclogging sprinklers, which will minimize the production of aerosols.

At a treatment plant flow of 40 mgd, 73,800 pounds of dry sludge solids would be applied to the site per day. This is equivalent to 53 tons of dry solids per acre per year, which is roughly equivalent to 0.4 inches of dry sludge added per year. This material would be periodically disced into the soil, probably a minimum of once a year.

The water included with the sludge solids would be lost by evaporation and transpiration, and theoretically none of it would reach the groundwater table. The average water application rate would be about 1.54 feet per year, and the average net evaporation rate (evaporation minus precipitation) is about 4.1 feet per year. These are average conditions, and some groundwater contamination could occur during periods of precipitation or other times when the precipitation plus water applied with the sludge exceeds net evaporation. Measured groundwater levels at the disposal site are 23-70 feet below the surface.

Sludge produced during unfavorable climatic conditions, such as during winter or freezing conditions, will be stored in basins at the disposal site until climatic conditions are favorable. Approximately 3 months of on-site sludge storage will be available. If application occurs only during 9 favorable months, the average rate will be 2.1 feet per year.

An earthen berm will be constructed along the perimeter of the site to contain surface runoff within the site and to divert surface runoff outside the site. Facilities at the disposal site will be constructed to have a low profile. The site will be landscaped with trees and shrubs. Several wells will be drilled around the perimeter of the site to monitor groundwater quality.

The Draft Master Project Facilities Plan recommends retaining several existing sludge drying beds at the treatment plant as emergency backup facilities.

Summary of Alternative Wastewater Treatment Process Costs

Costs of the nine alternatives vary widely, as some require rather complex advanced wastewater treatment processes with high annual operation and maintenance costs, and others less complicated land application alternatives which require rather extensive capital facilities. A summary of initial capital costs, annual operational costs, and total present worth costs is shown in Table 3-5. The majority of these alternatives are classified as alternative or innovative according to EPA definition and would therefore qualify for 85 percent federal funding. The two alternatives which are not alternative or innovative would still quality for 75 percent federal funding.

As shown in Table 3-5, Alternative L-1 has the lowest present worth cost of any of the alternatives, and Alternative T-6a is the next lowest cost alternative. The remaining seven alternatives, arranged in order of increasing cost, are T-14a, T-15, T-5, T-12, L-6, L-7, and T-9.

Actions Proposed by Reno and Sparks

The Master Project Facilities Plan (Kennedy/Jenks, 1980) prepared for the Cities of Reno and Sparks identifies a recommended facilities plan for wastewater treatment and sludge disposal. A summary description of their recommendations follows.

> *Based upon detailed analysis level estimates, Alternative L-1, Truckee Canal Diversion, is the most cost-effective effluent disposal alternative by a considerable margin. Although implementation of Alternative L-1 may require extensive action on the part of the cities, the alternative does present the best combination of low total present worth and low annual O&M expenditure as compared to the other viable alternatives. Therefore, Alternative L-1, Truckee Canal Diversion, is recommended as the apparent best wastewater project.*

Table 3-5. Summary of Costs Used in Detailed Screening Analysis (including sludge handling)

Alternative		Initial Capital Cost - $	Annual Operational Cost - $/yr	Total Present Worth Cost[1] - $
T-5	Fluidized bed nitrification/denitrification	35,000,000[2]	2,380,000	58,950,000
T-6a	Modified PhoStrip nitrification/denitrification	35,690,000[2]	1,030,000	45,170,000
T-9	Selective ion exchange	44,370,000	2,630,000	71,010,000
T-12	Trickling filter nitrification/denitrification	36,350,000	2,280,000	59,370,000
T-14a	Modified PhoStrip with denitrification polishing	38,090,000[2]	1,420,000	51,650,000
T-15	Trickling filter nitrification/fluidized bed denitrification	33,310,000[2]	2,250,000	55,920,000
L-1	Truckee canal diversion	37,020,000[2]	650,000	40,750,000
L-6	Dodge Flat irrigation with rapid infiltration	63,760,000[2]	640,000	60,210,000
L-7	Dodge Flat irrigation with Fernley drain	65,520,000[2]	350,000	61,440,000

[1] Calculated using 6 7/8 percent and 20-year life.

[2] Portions of these alternatives are considered as either "alternative" or "innovative" according to EPA definition.

Alternative S-12, Liquid Sludge to Spanish Springs Valley with Dedicated Land Disposal, is recommended as the apparent best sludge disposal project.

Recommended Plan

Description

General

The recommended plan consists of the following:

1. *Increasing the influent sewage pumping capacity by adding a sewage pump and modifying the pump discharge pipes.*
2. *Increasing the primary-secondary treatment capacity from 30 mgd to 40 mgd by adding sedimentation tanks similar to the existing tanks.*
3. *Increasing the capacity of phosphorus removal capability by adding a phosphorus stripping tank with appurtenances as required to employ the PhoStrip process.*
4. *Increasing the degree of treatment to provide tertiary filtration by adding gravity filters with appurtenances including a flow equalization basin.*
5. *Implementing effluent reuse by transporting the effluent to the Truckee Canal by a gravity pipeline.*
6. *Providing for handling increased quantities of sludge by adding a digestion tank and sludge pumping and piping facilities for transporting liquid digested sludge to a disposal site in Spanish Springs Valley.*

The proposed action is that of the Facilities Plan engineer and the two cities. The EPA does not have a facilities plan to recommend at this time. The EPA will review and evaluate the Reno-Sparks Facilities Plan in concert with the Draft EIS, comments made on the Draft Facilities Plan and the DEIS, State of Nevada recommendations, and other information and data before making a final determination on a project eligible for a grant award under section 201 of the Clean Water Act.

Allocation of Recommended Project Costs

The costs for the recommended project consist of costs to bring the capacity of the Early Start Project facilities up to a treatment capacity of 20 mgd, costs to increase the degree of treatment provided, costs to provide other improvements common to the full 40 mgd of treatment capacity, and costs of sludge transportation and disposal. Overall, when the Master Project is completed, the division of capacity will be 27 mgd to Reno, 11.5 mgd to Sparks, and 1.5 mgd to whichever city serves Sun Valley. Using the approach proposed in the draft Facilities Plan, the allocation of project costs would be:

	Total - $	Reno - $	Sparks - $	Sun Valley - $
Cost to increase ESP facilities to 20 mgd capacity	3,320,000	(-1,660,000)	2,490,000	2,490,000
Cost to increase degree of treatment & for facilities common to 40 mgd of capacity	33,570,000	22,660,000	9,650,000	1,260,000
TOTAL COST	36,890,000	21,000,000	12,140,000	3,750,000

At the present time, it is believed that the entire Master Project is eligible for 85 percent federal funding and that the septage and sludge handling and disposal portions of the Master Project are eligible for 75 percent federal funding. On this basis, the allocation of capital costs for Alternative L-1, including sludge handling, would be:

	Project Cost in February 1979	Funds Needed in 1981-1983*
Federal	$30,609,500	$40,568,300
Reno	3,575,200	4,738,400
Sparks	2,066,800	2,739,200
Sun Valley	638,500	846,100
TOTAL	$36,890,000	$48,892,000

*Based on an annual escalation rate of 8 percent from February 1979 to October 1982.

Operation and maintenance costs would be divided between Reno and Sparks in proportion to the wastewater flow contributed. When Sun Valley is also contributing, an identical approach will be used to divide operation and maintenance costs between the three entities.

Schedule for Implementation of the Recommended Project

The proposed schedule for implementation of the Master Project is:

Complete Facilities Plan, EIS, obtain concept approval, receive Step II grant and begin design	October 1980
Complete design	September 1981
Receive Step III grant and award construction contract	November 1981
Complete construction and begin operation	November 1983

Chapter 4

AFFECTED ENVIRONMENT

Introduction

In Chapter 1 a brief introduction to the study area is presented. In Chapter 4 a more in-depth treatment of the study area is presented, with emphasis on the key areas of impact of the JWPCP. The intent of this chapter is to present sufficient information for the reviewer to evaluate the impacts in Chapter 5.

Hydrology and water quality are the primary areas of emphasis in this chapter. The hydrologic analysis involves an extensive modeling of Truckee River flows to identify flow changes due to the JWPCP. The complexity of the basin hydrology, the detailed river management rules and the pending court cases that may change those rules made the modeling a necessary step in isolating JWPCP-induced changes from other influences on flow and quality.

In turn, the flow analysis formed the cornerstone of the water quality analyses. Analysis of the flow split at the Derby Dam diversion to the Truckee Canal to determine the resultant pollutant loading to Lahontan Reservoir and Pyramid Lake, and the availability of sufficient river flows to dilute JWPCP effluent to meet water quality standards are two key areas of the quality analysis that depended on the flow modeling.

Other areas of concern are addressed relative to their importance in the environmental analysis, tempered by the amount of information required to inform the reader of the basis for projecting impacts. All of the chapter is based on existing publications, file data and communications from knowledgeable individuals. No new field data have been gathered as part of the EIS.

Surface Hydrology - Truckee River Basin

The Truckee River watershed is a landlocked basin, with the headwaters located in the Sierra Nevada Mountains and terminus at Pyramid Lake in Nevada. The river runs 119 miles from its outlet at Lake Tahoe to Pyramid Lake (Figure 4-1).

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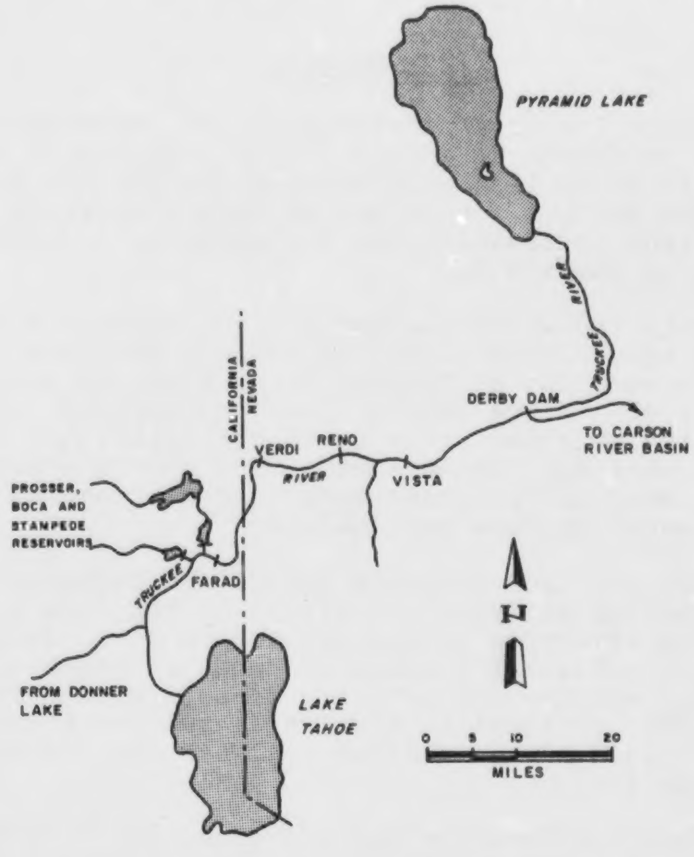
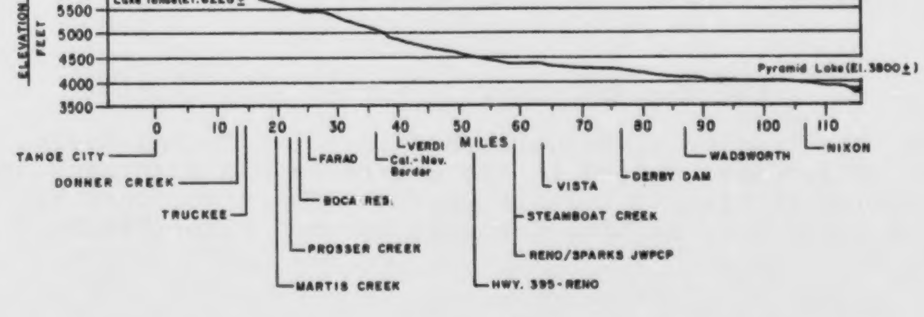
Figure 4-1

TRUCKEE RIVER



STREAM PROFILE OF THE TRUCKEE RIVER



SOURCE: PACIFIC ENVIRONMENTAL LABORATORY 1979

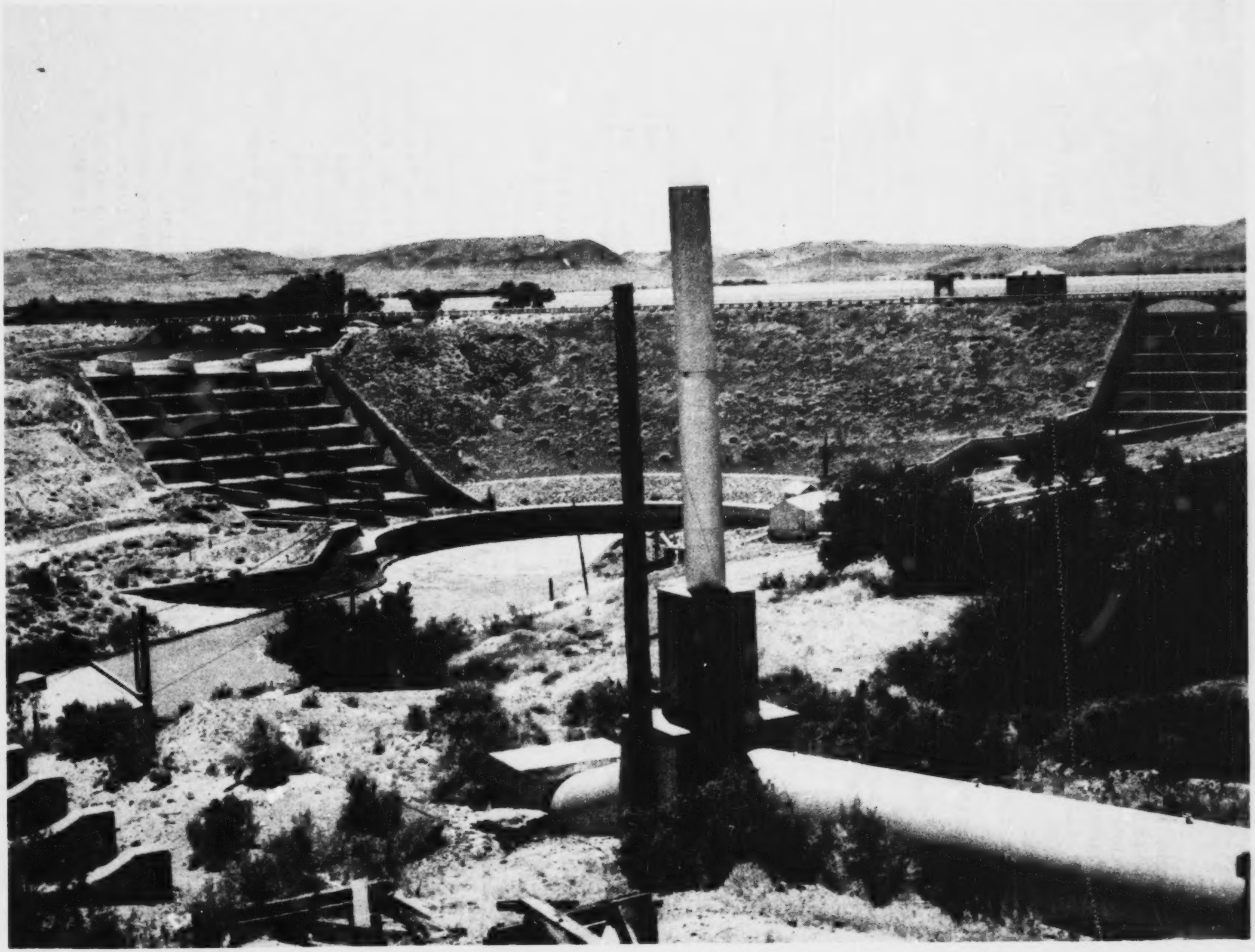
The Truckee River is regulated by dams on Lake Tahoe and several tributaries. The dams at Lake Tahoe, Independence Lake, and Donner Lake were constructed in the late 1800s. Since 1924, Webber Lake, Boca, Prosser, Martis Creek, and Stampede Dams have been constructed. These reservoirs are multipurpose, with irrigation, flood control, fish and wildlife, municipal and industrial being some of the identified uses. Although natural runoff is a significant factor in the river's flow regime, the reservoirs have enabled the flow in the river to be almost fully controlled during the majority of the time.

The flow of the Truckee River has been recorded at several points for most of this century. The gage at Farad was the first to go into continuous operation followed by the gage at Tahoe City. The gage at Farad has measured flow under several levels of regulation because each of the reservoirs went on line at different times. An excerpt from the historical flow record at Farad is given in Figure 4-2. Included in Figure 4-2 is the computed unregulated flow at Farad. The difference between the two lines is due to the reservoirs.

There are several legal and operating criteria that govern how the Truckee River system is operated as a whole. One of these criteria is the Floriston rates, a legal limit specifying flow at the Iceland gage near the state line at different times of the year. The rates, established in 1915 and revised in 1935, set minimum flows of 500 cfs for the summer and either 300, 350 or 400 cfs during the winter, depending upon the level of Lake Tahoe. The flows are met by storing runoff in reservoirs during wet periods and releasing water when needed.

Water is diverted from the Truckee River at several locations for both in-basin and out-of-basin uses. Water is transferred out of the basin at Lake Tahoe, Little Truckee River, and Derby Dam. The diversion at Derby Dam is by far the largest single diversion of water from the Truckee River. Derby Dam was constructed under the 1902 Reclamation Act to divert water into the Truckee Canal for irrigation of the Newlands Project within the Truckee and Carson River Basins. Water is often diverted year-round with summer diversions going to irrigation and winter diversions, when made, being stored in Lahontan Reservoir.

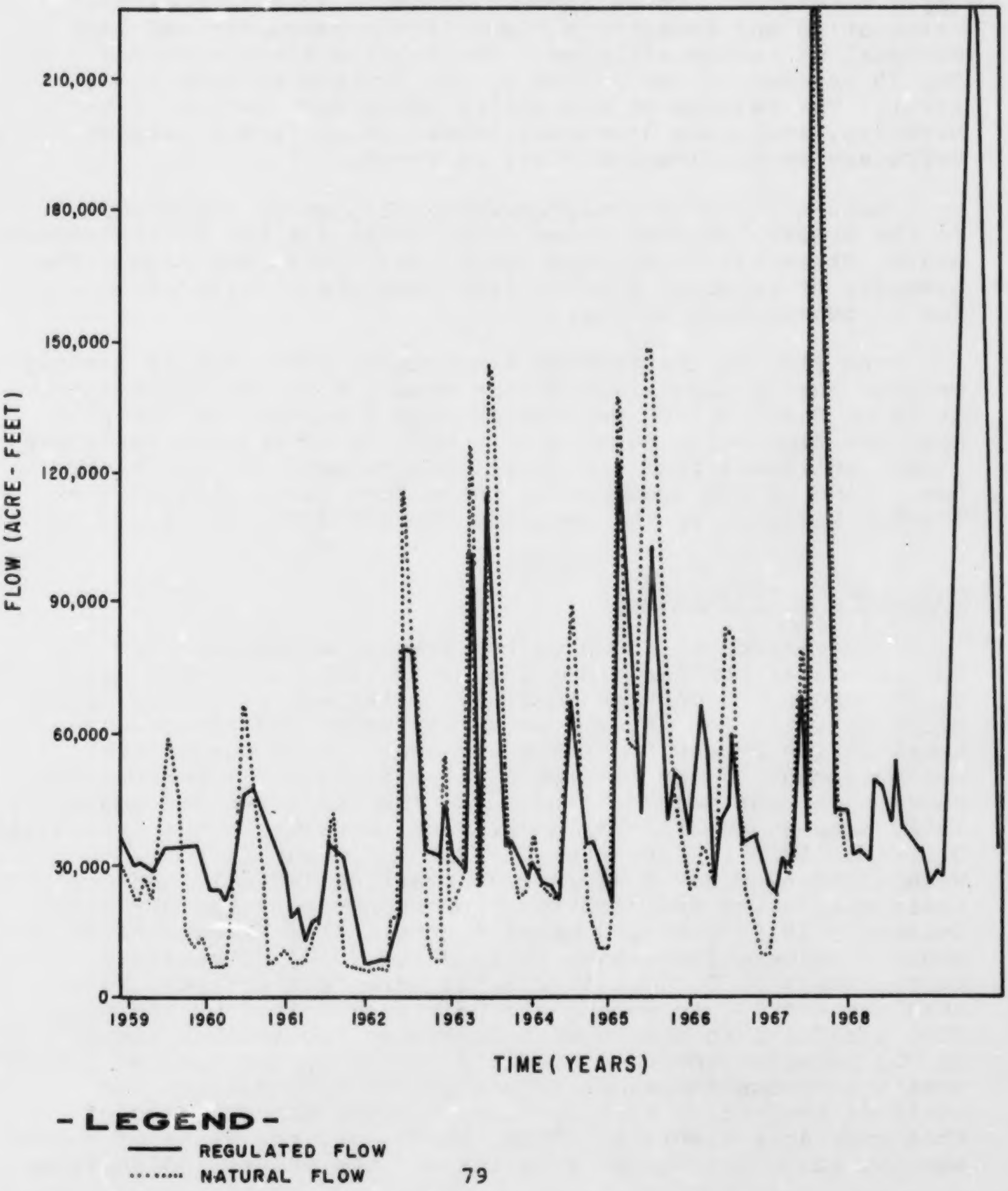
Most of the diversions for in-basin use occur within the Truckee Meadows for irrigation, power generation, and municipal and industrial uses. Irrigation diversions occur from April to October, while municipal/industrial diversions occur year-round. There are currently 18 diversions within the Truckee Meadows (DRI, and Walters Engineering, 1979).



Lahontan Dam Spillways with Penstock from Truckee Canal in Foreground.

Figure 4-2

A PORTION OF THE HISTORICAL HYDROGRAPH OF THE TRUCKEE RIVER AT FARAD



This is about half of the number of past diversions. Between Vista and Pyramid Lake, 15 ditches divert water from the Truckee River for agricultural irrigation between April and October. These are listed in Appendix E. Major diversion ditches in the Truckee Meadows are shown in Figure 4-3 and the average monthly diversions for several ditches are listed in Table 4-1.

The major inflows to the Truckee River occur in the upper watershed. These inflows are both surface flow from tributaries and subsurface flows from groundwater and land disposal of sewage effluent. The Truckee River accounts for 75 percent of the inflow to the Truckee Meadows (DWR, 1973). The balance of the inflow comes from various tributaries, including Steamboat Creek, which is the largest tributary to the Truckee River in Nevada.

Return flows of diverted water also enter the river. In the Truckee Meadows these flows enter via the North Truckee Drain, Steamboat Creek, the JWPCP, and direct drainage. The quantity of returned flow is less than the diverted flow due to consumptive losses.

The flow of the Truckee River below Derby Dam is greatly reduced during some times of the year due to the diversion at Derby Dam. During periods of high diversion at Derby Dam, the flow below Derby Dam is made up of groundwater accretions, spillback from the canal, and seepage through Derby Dam. Some of the groundwater comes from irrigation of the Truckee Division of the Newlands Project (DOI, 1977).

Institutional Influences

The control of flows on the Truckee River has been a controversial process since the early 1900s involving litigation and court decrees that have resulted in various operating criteria for the system's reservoirs and diversions. Legal action by the federal government led to the initial establishment of the Floriston rates in 1915. Subsequently, there have been many actions: the Truckee River Agreement, 1935, between the federal government, Truckee-Carson Irrigation District (TCID), Sierra Pacific Power Company (SPPCo), the Washoe County Water Conservation District (WCWCD), and certain individual users modified the Floriston rates; the Orr Ditch Decree in 1944 specified water rights in the Truckee River basin; the Gesell decision in 1973 set TCID's diversions to the Newlands Project at 288,128 acre-feet per year rather than the 406,000 acre-feet per year promulgated by the DOI; TCID's refusal to comply with diversion regulations issued by DOI pursuant to Judge Gesell's decision; the federal government's attempts to cancel TCID's contract to operate the Newlands Project; a suit by TCID to block cancellation of that contract; a suit by CTWCD, SPPCo, and the State of Nevada against the Secretary of Interior and the Paiute Indian Tribe

Figure 4-3

MAJOR IRRIGATION DITCHES WITHIN THE TRUCKEE MEADOWS

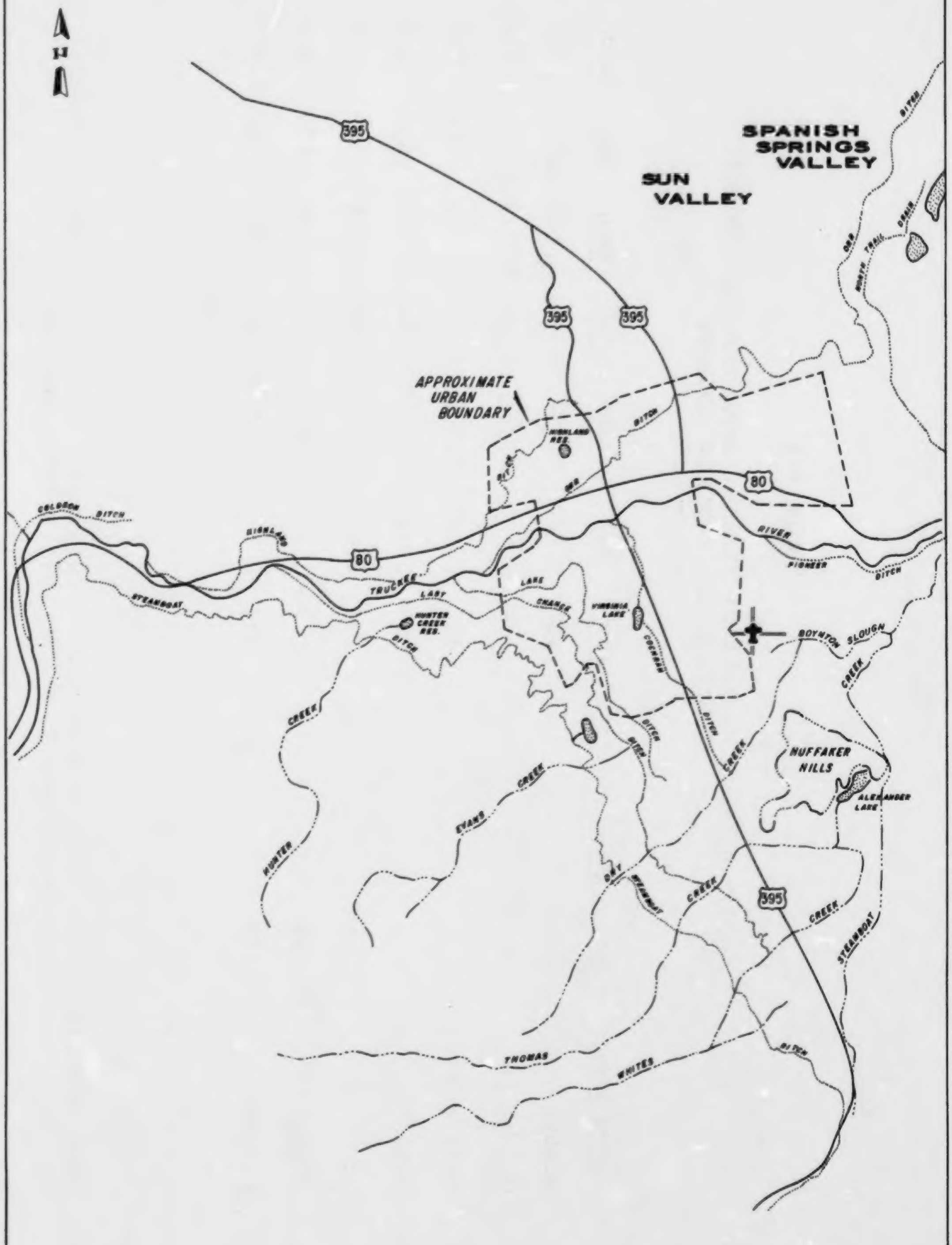


Table 4-1

AVERAGE MONTHLY DIVERSIONS INTO SEVERAL DITCHES WITHIN THE TRUCKEE MEADOWS[1]

(acre-feet)

Ditch Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steamboat				1,501	5,682	5,754	6,183	5,834	4,489	2,806		
Highland				2,096	4,129	4,586	4,976	4,825	4,116	3,314	2,695	1,671
Last Chance				327	1,491	1,533	1,774	1,706	910	561		
Lake				358	1,838	1,906	1,984	1,992	1,583	889		
Orr			116	2,193	4,665	2,911	4,643	4,376	3,049	2,032	432	357
Idlewild	1,304	1,150	1,311	682	651	1,065	1,431	1,126	879	468	287	262
Pioneer	176	159	264	975	2,033	2,220	815	1,982	1,447	1,097	260	390

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[1] Average of 1975-1977.

DATA SOURCE: Water Masters Records, unpublished. Available from the Federal Water Masters Office, P. O. Box 3571, Reno, Nevada.

to change the operation of Stampede Reservoir to include M&I purposes; and others. Actions completed and pending are addressed in more detail in Appendix C.

Depending on the outcome of pending cases, particularly the litigation on operation of the Newlands project and the suit on the operation of Stampede Reservoir, significant changes in the flow regime of the Truckee River could result. Uncertainties about how flow in the river will be regulated tend to complicate the identification of river flow and water quality changes that could result from the JWPCP options. To overcome this difficulty scenarios of potential future flow conditions have been developed and tested relative to the Master Project alternatives.

Hydrologic Modeling

In view of the complexity of the Truckee River system and its interrelated reservoir and diversion operating criteria, the unpredictable outcomes of litigation, and the effects of future growth on water use in the Truckee Meadows, it was decided to use a computerized model to identify those changes in flow likely to be caused by Master Project alternatives and to then separate these changes from changes likely to be caused by other influences. The Water and Power Resources Service (WPRS) (formerly the U. S. Bureau of Reclamation) developed a computer model of the river that reflects, to a reasonably accurate degree, the behavior of the Truckee River under current operating criteria. The model embodies the 75-year hydrologic record that started in 1900 and allows the imposition of user-selected basin management methods, i.e., criteria, and thereby allows an investigator to operate the river system model on an idealized, consistent basis for the 75-year period of record. Thus, the model creates an idealized, simulated output of what Truckee River flows would have been if the selected conditions had existed for the entire 75 years.

The WPRS model was modified for this EIS analysis to reflect a series of input assumptions relating to operational scenarios selected to represent the range within which Truckee River management could occur. The scenario operations represent future possibilities, such as future water consumption, conversion of agricultural lands to urban use, and alternative outcomes for the major pending litigations on the Truckee River.

The scenario analysis is especially pertinent, because the actual operation of the river probably cannot be replicated with great accuracy by any model. This occurs for several reasons. Although the day-to-day operations of facilities on the river are guided strongly by the established criteria, the actual operation differs due to many natural and human factors. Hydrologic data are not perfectly measured, diversions are seldom operated exactly as operating criteria would dictate, and management techniques by practical necessity undergo subtle or dramatic changes in times of flood and drought.

Since the main objective of modeling for the EIS analysis is to isolate and quantify the effects of the JWPCP Master Project alternatives relative to other major variables affecting the river, the use of the model output is largely confined to a series of sensitivity analyses. As the first step, one scenario, reflecting one possible growth level in the Truckee Meadows and one possible set of reservoir and diversion management criteria, was selected and modeled to include the three JWPCP wastewater disposal alternatives. The same process was repeated for other growth scenarios and river management scenarios. A full explanation of model assumptions and output is contained in Appendix G. The percentage change in Truckee River flow corresponding to each Master Project disposal alternative was determined for each series of model runs. The results are compared in the following text and tables.

A discussion of model assumptions, scenarios and model output follows.

Model Assumptions. The assumptions developed for the model provide a relatively broad range of potential future conditions of flow in the Truckee River. It was assumed that the 75-year hydrologic record reasonably represents the range of drought and flood conditions likely to occur in the future. Assumptions as to water consumption changes, decrease in Truckee Meadows agriculture, and alternative management methods for the Truckee River system were developed to bracket the more likely ranges of future conditions. Urban growth, for instance, is expected to increase M&I water use while decreasing agricultural water use. This exchange is a function of land use and related to population size. In order to evaluate changes in the types of water use that could occur during the 20-year planning period, three possible points in Reno's projected growth were defined.

The first point, representing 1979, was determined from aerial photographs of the Truckee Meadows, population estimates (Appendix A), SPPCo water consumption data, and an estimate of the irrigated land in the Truckee Meadows in 1978 by URS Company (1978a).

The second point was selected as being the completion of the short-term residential growth projected by Gruen Gruen + Associates (Appendix A). The residential growth projections were supplemented by a consistent mix of commercial, industrial, and various public land uses distributed in accordance with the adopted general plan. Irrigated acreage displaced by urban growth was translated into reduced irrigation diversions. The estimated 1979 per capita water usage factors were applied to the population that would occupy the housing stock represented by the short-term growth. This intermediate Truckee Meadows population is estimated at 230,354, which could be achieved by 1985 under relatively rapid growth conditions. For the EIS analysis, this population, land use, water use condition is defined as the 1985 Truckee Meadows stage of growth. At 1979 water usage rates, the sewage flow from this 1985 population would average about 30 mgd or the flow that can be accommodated by the ESP.

The third point in the growth curve was selected to provide an outside estimate of growth in the Truckee Meadows within the next 20 years, recognizing that such a level might not be reached until after the year 2000. A review of extant population estimates led to the use of the State Planning Coordinator's estimates, both because they are higher than most other estimates and because they have considerable official stature. The high-limit year 2000+ population used for the Truckee Meadows is 374,639. The residential land uses necessary to accommodate this population were estimated along with a consistent mix of commercial, industrial and public land uses. Urban water use was projected at the 1979 per capita rate. This is probably an excessive use case because water conservation is likely to be practiced in the future, but no policy on this matter is fully developed or implemented. Where urban land uses were assumed to replace irrigated agriculture, agricultural water use was reduced. This population land use mix is used as the Truckee Meadows growth in this analysis, even though this population level may not be reached for some years after 2000. The peak monthly wastewater flow generated under these assumptions would approximate 51 mgd if existing per capita water use were to continue.

As can be seen, the growth scenarios bracket the growth that would be accommodated by the JWPCP Master Project at a capacity of 40 mgd. Thus, results from the year 2000 plus growth provide an indication of conditions that might result if Reno grew beyond the size contemplated for the proposed JWPCP Master Project construction. However, since the analyses assume 1979 per capita M&I water consumption rates, and since per capita water consumption could decrease with meters or other conservation techniques, it is possible that a 40 mgd plant could accommodate a larger population than presently projected for that size of plant. A 40 mgd JWPCP together with package plants could also accommodate this higher population. Thus, for purposes of the analyses in this EIS the larger of the population estimates provides the most flexible tool for analyzing the effects of growth on river flow.

It was necessary to relate volumes of water to acres of irrigated land using a demand in acre-feet per acre per year to estimate reductions in agricultural diversion to the Truckee Meadows as urban irrigation replaces agriculture. In order to use legally-sanctioned criteria, the irrigation duties and ditch losses specified in the Orr Ditch Decree were used for all model evaluations; however, Orr Ditch Decree diversions appear to be substantially lower than the actual diversions (an average diversion of about 4.5 acre-feet per acre per year as compared to nearly 8 acre-feet per acre per year at present). The use of the Orr Ditch Decree criteria tends to yield a greater annual average flow at Vista than is indicated in recent historical records.

Of the water diverted, part is consumptively used and part is returned to the Truckee River system. The return flows to the river were estimated from a computed water balance for the Truckee Meadows, with seasonally variable return percentages from agricultural uses and M&I uses. A groundwater recharge component was also included.

The criteria used to divert water for use by TCID, and to manage the river to meet these diversion needs, are among the more dominant factors influencing the operation of the Truckee River system. As the largest single user of Truckee River water, the TCID has a major effect upon the operation of the system.

The operation of the system may vary in the future according to legal decisions relating to water management on the Truckee and Carson Rivers. The criteria that determine how TCID diversion rights to Truckee River water are met include irrigation demand by Newlands Project lands, the amount of water already stored in Lahontan Reservoir, and operating rules for reservoirs on the Truckee River system. The three influences on these criteria that are most likely to be affected by pending litigation are the amount of Newlands Project demands, the rate and timing of diversions to meet those demands, and the uses of stored Stampede Reservoir water.

The three mixes of these variables selected for the bases of the hydrologic modeling are described as follows.

Existing Operating Criteria. In 1967 the USBR (now the WPRS) established TCID's demand at 406,000 acre-feet per year, and established reservoir operating criteria and diversion schedules for meeting the demand. These schedules are referred to as the 406 criteria. The diversions called for by the schedules vary, depending upon storage in Lahontan Reservoir and forecast runoff. Since 1967 the diversions into the Truckee Canal have reflected TCID's attempts to meet the 406,000 acre-feet demand by implementing the associated diversion criteria.

However, Judge Gesell's decision in 1973 held that the Secretary of Interior had to provide greater flows for the Pyramid Lake fishery, set the Newlands Project demand at 288,129 acre-feet, and direct the Secretary of Interior to promulgate criteria to meet that demand. The secretary published the regulations, but TCID, which was not a party to the suit that resulted in the Gesell decision, refused to abide. The question is pending in the courts, and in the meantime, TCID has continued to divert water based on a demand of up to 406,000 acre-feet per year.

Stampede Reservoir has been operated for flood control, fish and wildlife, and recreation needs since its construction, with no current provision for the municipal and industrial storage that was originally intended.

Since 1973 fishery releases have been made under the Gesell Decision, which specifies 600 cfs from March 1 to May 15, 300 cfs from May 16 to September 15, and 150 cfs from September 16 to February 28. Judge Gesell's decision also allocated potential storage credits in Stampede Reservoir to TCID for agricultural use. The use of this storage arrangement has not occurred. Further, the TCWCD, SPPCo and the State of Nevada have sued the Secretary of the Interior to implement the M&I use for Stampede Reservoir. Neither of these issues involving Stampede Reservoir has been resolved to date, and the operation presently emphasizes benefits to the threatened and endangered fish species in the Truckee River and Pyramid Lake. It is this present situation that is embodied in the model's existing criteria.

The criteria governing the operation of the Truckee River system in the future will reflect the outcome of current litigation. It will most likely involve changes from existing conditions since each party involved in the litigation has objections to certain components of the current criteria.

Bureau of Reclamation Criteria (406). One possible outcome of existing litigation could be to recognize the validity of the 406,000 acre-feet per year demand of the Newlands Project; to implement M&I uses of Stampede Reservoir; and yet to retain Judge Gesell's provision for TCID storage credits in Stampede Reservoir. Such a combination of possible outcomes is felt to represent one of the larger depletions of Truckee River water likely to result from the current actions. This combination was used as the 406 criteria in the model analysis. While not in strict accord with the 406 criteria promulgated by WPRS prior to Judge Gesell's decision, it would embody a 406,000 acre-feet per year demand for the Newlands Project and the basic WPRS diversion schedule, with provision for storage of exchange water in Stampede Reservoir.

The 406 criteria used for modeling incorporate a 6,300 acre-feet per year firm yield from Stampede Reservoir for fishery purposes. These flows were assumed to be released on a uniform year-round basis. The criteria also include an M&I component for Stampede Reservoir according to the original (but never executed) reservoir contract. This would include provision of 17,000 acre-feet of firm yield of Stampede Reservoir water for SPPCo M&I use. In order to reflect a condition as different as possible from the Gesell criteria, it was decided to use the original contract provisions in the 406 criteria for model purposes.

Gesell Criteria (288). The Gesell, or 288, criteria are derived from the 1973 decision of Judge Gesell that TCID's need for irrigation water should be 288,129 acre-feet per year and that Stampede Reservoir must be operated for flood control, fish and wildlife, recreation and to store water for possible use by TCID. The criteria are designed to minimize the use of Truckee River water in the Newlands Project and increase flows to Pyramid Lake to protect the endangered and threatened fish species. The Gesell decision would result in lower diversions into the Truckee Canal than in the 406 criteria, and requires specific releases from Stampede Reservoir to meet fishery needs. Those releases are 600 cfs from March 1 to May 15, 300 cfs from May 16 to September 15, and 150 cfs from September 16 to February 28.

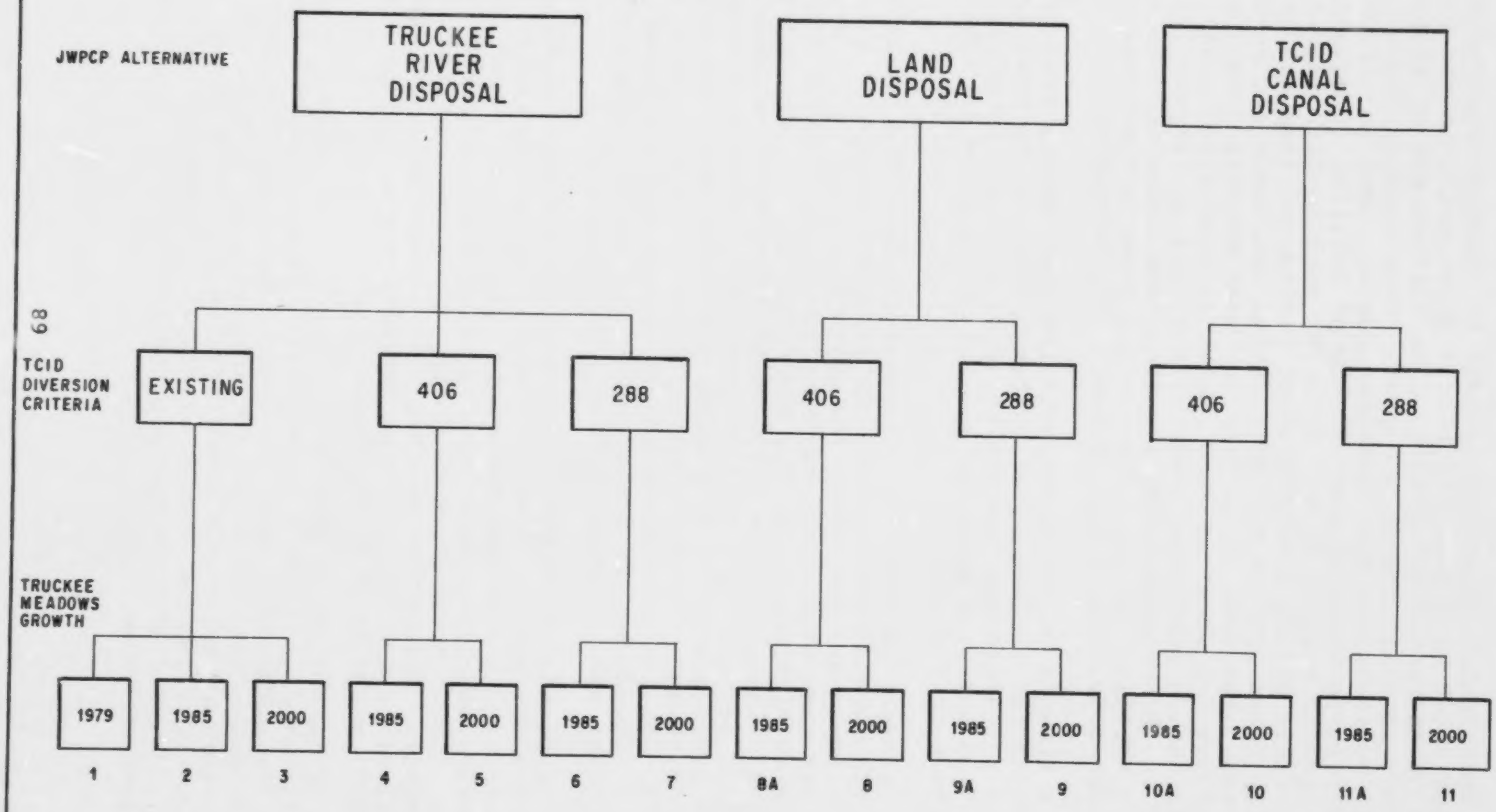
The Gesell decision allocates storage for TCID exchange water in Stampede Reservoir. In order to represent a wider range of potential future conditions on the Truckee River, the input assumption was made that TCID would not have such a credit in Stampede Reservoir. Thus, the 288 criteria used for model input do not exactly follow Judge Gesell's decision. The 288 criteria and 406 criteria employed in the modeling should bracket the range of likely conditions, however, and provide an appropriate background against which to identify any JWPCP impacts.

Model Output Analysis. The model was then operated for 15 different scenarios representing sufficient combinations of assumptions about future events to enable separation of JWPCP effects from other influences. Figure 4-4 graphically illustrates the assumptions used in those scenarios. Model output was then analyzed to isolate and quantify the effects on river flow of JWPCP alternatives.

Analyses were made for four basic time frames: Mean annual flow; mean monthly flow (flow-duration probability relationships); once in 10-year low mean monthly flow; and the major drought periods (annual or monthly, as appropriate). Each analysis provides insight into the relative response of the river to any change in the amount or location of effluent disposal from the JWPCP. When only one input assumption is changed between scenarios, it is possible to compare the resulting change in river flow and thus identify a possible cause/effect relationship.

Figure 4-4

DIAGRAM OF SCENARIOS
JWPCP HYDROLOGIC IMPACT ANALYSIS



JONES & STOKES ASSOCIATES, INC.

Mean annual flows can be used to identify whether more or less water will annually pass a given point on the river for a given scenario. Pyramid Lake inflows are of special interest in this type of analysis. Mean monthly flows, comparatively presented as flow duration curves, tend to vividly illustrate relative changes in the probability of equalling or exceeding a given flow. In cases such as fish requirements, where flows during specific short periods of time are critical, monthly flows provide the most useful benchmark for comparative analyses. The once in 10-year low mean monthly flow (herein termed low Q_{10} flow) is very useful in both water quality and fisheries analyses. Generally a once in 10-year 7-day low flow is considered the low flow event that must be used during facility design. The low Q_{10} flow is the closest that the model output can approach this criterion.

A drought period represents the most severe test of operating the Truckee River system. This is the most critical period for achieving protection of many of the beneficial uses, and a review of water deficits during the drought of the 1930s is informative.

In order to evaluate the sensitivity of the assumption that TCID would have a credit in Stampede Reservoir under 406 criteria and not under 288 criteria, one pair of evaluation runs was made with the assumption reversed. With a TCID credit in Stampede under the 288 criteria, but not under the 406 criteria, there would be no significant differences in river response upstream of Derby Dam. The trial assumptions yield a smaller flow below Derby Dam under 406 criteria with no Stampede credit than under 406 criteria with a Stampede credit. In the same reach the trial assumptions yield a larger flow under 288 criteria with a TCID Stampede credit than under 288 criteria without a Stampede credit.

Thus, the assumption used by Jones & Stokes provides a narrower range of flows between the two criteria. The TCID credit in Stampede Reservoir acts to bypass more water at Derby Dam. Therefore, whichever criteria utilizes the credit allows more water to Pyramid Lake and less to Lahontan Reservoir. Irrigation shortages in the Carson and Truckee Divisions of the Newlands Project were the same regardless of TCID credit in Stampede Reservoir.

Model Derived Conclusions. Analysis of the model output revealed that the JWPCP flow-related impacts could be separated from the effects of other influences on river flow even though the Truckee River is a complex interrelated system. In many instances the effects of implementing one JWPCP option over another on river flow were largely independent of other influences. The following sections discuss the results for each type of flow analysis.

Mean Annual Flow. As might be expected, those JWPCP options that do not return the effluent to the Truckee River or Truckee Canal (Alternatives L-6 and L-7) reduce flows in the river. The Dodge Flat land disposal options would reduce the mean annual flow in the Truckee River from Vista to Pyramid Lake by about 8 percent as compared to Truckee River discharge (Alternatives T-5, T-6, T-9, T-12, T-14, and T-15). This alternative would cause an annual decrease in inflow to Pyramid Lake of about 9 percent as compared to river disposal. These same percentages show up regardless of whether the 288 or 406 criteria are applied, indicating that the effects of the JWPCP on annual flow between Vista and Derby Dam and annual inflow to Pyramid Lake are not sensitive to the likely range of future flow management decisions that can be expected on the Truckee River. (Short-term flows in the Truckee River are affected by the JWPCP disposal options, and these effects are discussed in subsequent evaluations of monthly flows.)

Effluent disposal to the Truckee Canal (Alternative L-1) would decrease the mean annual flow in the Vista to Derby Dam reach of the river by about 8 percent, regardless of river operating criteria. Below Derby Dam there would be virtually no difference in mean annual flow with Alternative L-1 indicating little difference in annual inflow to Pyramid Lake between disposal to the Truckee Canal and discharge to the Truckee River above Vista.

Table 4-2 compares annual flows at selected locations on the Truckee River under various assumptions used in the model. All comparisons are to the river disposal option which is given a base value of 100. For example, a value of 150 indicates a value 50 percentage units greater than the river disposal condition.

Table 4-2 includes spills from Lahontan Reservoir on an average annual basis. This is water that exceeds the storage capability of Lahontan Reservoir, or which must be released to provide storage for expected inflow. When spilled the water benefits the Stillwater Wildlife Refuge. Spills would be greatest under the Truckee Canal disposal alternative since effluent is being diverted from the Truckee River basin to the Carson River basin at all times, even when Lahontan Reservoir may be spilling.

A second major annual flow-related question posed by the Master Project is the effect of urban growth on river flows, water quality, and Truckee River beneficial uses. The effects of growth on Truckee River flow were evaluated by comparing the effects of scenarios with identical river management and JWPCP options on annual flow at Vista where population size was the variable (Table 4-3). The model results indicate slight decreases (up to 5 percent at 40 mgd) in annual river flow at Vista due to growth. However,

Table 4-2. Comparison of Calculated Relative Changes in Mean Annual Truckee River Flows in Response to JWPCP Effluent Disposal Options (river disposal = 100)

	Truckee River Disposal (40 mgd, 406 Criteria)	Dodge Flat Disposal (40 mgd, 406 Criteria)	Truckee Canal Disposal (40 mgd, 406 Criteria)
Farad	100	100	100
Vista	100	92	92
Derby Dam	100	92	92
Diversion into Truckee Canal[1]	100	95	98
Pyramid Lake Inflow	100	91	99
Lahontan Reservoir Spills	100	96	119

	Truckee River Disposal (40 mgd, 288 Criteria)	Dodge Flat Disposal (40 mgd, 288 Criteria)	Truckee Canal Disposal (40 mgd, 288 Criteria)
Farad	100	100	100
Vista	100	92	92
Derby Dam	100	92	92
Diversion into Truckee Canal[1]	100	95	101
Pyramid Lake Inflow	100	92	98
Lahontan Reservoir Spills	100	98	121

Footnotes:

[1] Includes effluent for Truckee Canal disposal alternative.

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

Table 4-3. Comparison of Calculated Relative Changes in Mean Annual Truckee River Flows in Response to Urbanization in Truckee Meadows

(1985 [30 mgd] = 100, each case)

	406 Criteria								
	Truckee River Disposal			Dodge Flat Disposal			Truckee Canal Disposal		
	30 mgd	40 mgd	51 mgd	30 mgd	40 mgd	51 mgd	30 mgd	40 mgd	51 mgd
Farad	100	100	100	100	100	100	100	100	100
Vista	100	99	98	100	97	94	100	95	93
Derby Dam	100	99	98	100	97	94	100	95	93
Diversion into Truckee Canal[1]	100	100	100	100	98	96	100	100	100
Pyramid Lake Inflow	100	99	98	100	96	93	100	98	96
	288 Criteria								
Farad	100	100	100	100	100	100	100	100	100
Vista	100	99	98	100	96	93	100	97	94
Derby Dam	100	97	98	100	96	93	100	97	94
Diversion into Truckee Canal[1]	100	99	99	100	98	96	100	102	106
Pyramid Lake Inflow	100	99	98	100	96	93	100	98	96

[1] Includes effluent for Truckee Canal disposal alternative.

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

this conclusion is sensitive to the model assumption that Truckee Meadows agricultural diversions exactly follow the Orr Ditch Decree duties and ditch losses. If a different assumption is employed, namely use of recent historic diversion rates with diverted amounts and depletions reduced proportionately as agriculture is replaced by urban land uses, the effect of urban growth on mean annual river flow becomes negligible.

In conclusion, the urbanization of the Truckee Meadows may have a small to unmeasurable effect on mean annual flows in the Truckee River depending on how agricultural diversions to the Truckee Meadows are actually made.

Monthly Flows. Monthly flow values for the Truckee River were analyzed in two ways: (1) flow duration curves were prepared for two locations (Vista and Pyramid Lake inflow) for March, June, August, and November as input to fishery impact analyses (Appendix E); and (2) once in 10-year low mean monthly flows (low Q_{10} flows) were analyzed at several locations for each month as input to water quality and fishery impact analyses.

The flow duration curves in Appendix E represent the probability that a given flow will be equalled or exceeded. The figures allow visual comparison of flow differences under various assumptions for each disposal option in March (beginning of spring spawning period), June (end of spring spawning-incubation period), August (low summer flow period, when most critical water quality conditions occur), and November (fall-winter spawning period). The once in 10-year low flow value can be visually determined as the flow value at the 90 percent exceedence point on the curves.

The conclusions derived from the low Q_{10} flow analysis are presented in Tables 4-4 and 4-5, summarized in Tables 4-6 and 4-7, and discussed as follows. The reader should note that most of the conclusions are presented in relative terms comparing Truckee Canal disposal and land disposal to Truckee River disposal. While quantitative flow differences are calculated as a result of the two river management criteria selected for modeling, the relative differences are of primary importance in separating JWPCP influences from other influences.

The conclusions reflect the complexity of river operating rules, particularly regarding Farad, where the conclusions predict certain flow changes at that point, even though Farad is upstream of the Truckee Meadows diversions. When downstream diversions, JWPCP discharges or other operating rules are changed between model scenarios, the system reacts by following the established rules for releasing water. Under different scenarios, minor differences in releases can occur. This may deplete upstream storage earlier than the base case or

Table 4-4. Comparison of Calculated Relative Changes in 1-in-10-Year
Mean Monthly Low Truckee River Flows At Selected Locations
Due to Changes in JWPCP Effluent Disposal Options.
(river disposal = 100)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Dodge Flat Disposal (40 mgd, 406 Criteria)											
Farad	100	100	100	100	100	100	100	100	100	47	83	100
Vista	82	83	85	88	87	84	81	82	84	35	57	72
Derby Dam	82	83	85	87	86	84	80	82	83	35	57	72
Diversion into Truckee Canal[1]	ND	ND	100	100	100	100	100	100	100	100	100	ND
Pyramid Lake Inflow	100	100	96	93	95	88	94	94	96	64	73	98
	Dodge Flat Disposal (40 mgd, 288 Criteria)											
Farad	96	100	103	109	90	105	101	100	106	89	123	100
Vista	79	82	85	104	83	92	79	81	86	53	84	66
Derby Dam	79	82	85	104	82	91	78	81	86	53	84	66
Diversion into Truckee Canal[1]	ND	ND	100	100	100	100	100	100	100	100	100	ND
Pyramid Lake Inflow	64	51	80	91	100	87	45	63	33	30	27	34

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Truckee Canal Disposal (40 mgd, 406 Criteria)											
Farad	100	100	100	100	100	100	100	100	100	100	100	100
Vista	82	83	85	87	86	84	81	82	84	85	72	72
Derby Dam	82	83	85	87	86	84	80	82	84	85	72	72
Diversion into Truckee Canal[1]	∞[2]	∞[2]	180	80	87	90	86	84	73	94	219	∞[2]
Pyramid Lake Inflow	98	98	96	93	91	91	93	94	98	98	85	86
	Truckee Canal Disposal (40 mgd, 288 Criteria)											
Farad	96	100	104	100	94	100	100	100	114	105	122	112
Vista	79	84	91	89	87	83	85	83	97	80	81	74
Derby Dam	79	84	91	89	87	83	84	83	96	80	81	74
Diversion into Truckee Canal[1]	∞[2]	∞[2]	262	110	85	85	73	72	82	139	339	∞[2]
Pyramid Lake Inflow	275	107	87	113	100	100	116	103	111	103	84	94

Legend:

ND - No diversion into the Truckee Canal for this month.

Footnotes:

[1] Includes effluent for Truckee Canal disposal alternative.
[2] Flow in the canal is equivalent to the effluent while there is no diversion into the canal under river disposal.

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

Table 4-5. Comparison of Relative Changes in Calculated 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations Due to Incremental Truckee Meadows Growth from 30 mgd to 40 mgd Population Equivalent. Percent of Base Case (1985 Growth)[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Truckee River Disposal, 406 Criteria												Truckee River Disposal, 288 Criteria											
Farad	100	100	100	100	100	100	100	100	100	100	99	100	104	100	101	101	100	100	103	100	100	98	100	100
Vista	97	99	98	99	100	97	95	96	99	100	77	97	101	98	99	100	100	97	97	95	98	99	97	94
Derby Dam	97	99	98	98	100	97	94	96	99	100	97	97	101	98	99	100	100	97	97	95	98	99	97	94
Diversion into Truckee Canal	ND	ND	100	100	100	100	100	100	100	100	100	ND	ND	ND	100	100	100	100	100	100	100	100	100	ND
Pyramid Lake Inflow	100	100	100	99	97	98	98	100	100	100	100	100	67	88	91	97	100	100	88	94	97	99	94	100
	Dodge Flat Disposal, 406 Criteria												Dodge Flat Disposal, 288 Criteria											
Farad	100	100	100	100	100	100	100	100	100	86	88	100	100	100	97	104	98	104	97	100	97	95	99	100
Vista	92	93	93	95	98	98	89	90	94	85	74	87	92	91	95	100	97	99	83	91	88	84	87	86
Derby Dam	92	93	93	95	98	92	89	90	94	85	74	87	92	91	95	100	97	99	83	90	87	84	87	86
Diversion into Truckee Canal	ND	ND	100	100	100	100	100	99	100	99	100	ND	ND	ND	100	100	100	100	100	100	100	100	100	ND
Pyramid Lake Inflow	100	98	100	96	98	94	96	98	100	90	84	98	98	68	94	94	100	87	58	74	68	68	96	67
	Truckee Canal Disposal, 406 Criteria												Truckee Canal Disposal, 288 Criteria											
Farad	100	100	100	100	100	100	100	100	100	100	101	100	100	100	101	104	94	100	103	100	103	100	103	112
Vista	92	93	93	95	97	92	88	90	94	96	89	88	92	93	96	100	92	92	96	91	97	90	92	88
Derby Dam	92	93	93	95	97	92	88	90	94	95	89	88	92	93	96	100	92	92	96	90	97	90	92	88
Diversion into Truckee Canal[2]	132	132	132	94	96	97	95	94	90	132	132	132	132	132	132	132	101	95	90	91	132	132	132	132
Pyramid Lake Inflow	98	98	100	97	102	96	96	98	98	98	94	91	100	93	93	100	100	100	100	94	89	89	77	94

LEGEND

ND - No diversion into the Truckee Canal for this month.

FOOTNOTES

[1] 1985 (30 mgd) growth level with otherwise identical criteria used as basis of 100 in each case. Each comparison is between 30 mgd and 40 mgd equivalent population levels, and is not a direct comparison between management criteria or Master Project options.

[2] These percentages include effluent for the Truckee Canal disposal alternative. These figures do not imply a shortfall to TCID.

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

Table 4-6. Summary of Calculated Relative Changes in 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations Due to JWPCP Disposal Options (river disposal = 100)

	Truckee River Disposal (40 mgd, 406 Criteria)		Dodge Flat Disposal (40 mgd, 406 Criteria)		Truckee Canal Disposal (40 mgd, 406 Criteria)	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Farad	100	100	100	47	100	100
Vista	100	100	88	35	87	72
Derby Dam	100	100	87	35	87	72
Pyramid Lake Inflow	100	100	100	64	98	85

	Truckee River Disposal (40 mgd, 288 Criteria)		Dodge Flat Disposal (40 mgd, 288 Criteria)		Truckee Canal Disposal (40 mgd, 288 Criteria)	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Farad	100	100	123	89	122	94
Vista	100	100	104	53	97	74
Derby Dam	100	100	104	53	96	74
Pyramid Lake Inflow	100	100	100	27	275	84

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

Table 4-7. Summary of Calculated Changes in 1-in-10-Year Mean Monthly Low Truckee River Flows at Selected Locations due to Truckee Meadows Growth from 30-40 mgd Equivalent Population (1985 conditions = 100)

	Truckee River Disposal (406 Criteria)		Dodge Flat Disposal (406 Criteria)		Truckee Canal Disposal (406 Criteria)	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Farad	100	99	100	86	101	100
Vista	100	77	98	74	97	88
Derby Dam	100	94	98	74	97	88
Pyramid Lake Inflow	100	97	100	84	102	91

	Truckee River Disposal (288 Criteria)		Dodge Flat Disposal (288 Criteria)		Truckee Canal Disposal (288 Criteria)	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Farad	104	98	104	95	112	94
Vista	101	94	100	83	100	88
Derby Dam	101	94	100	83	100	88
Pyramid Lake Inflow	100	67	100	58	100	77

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

otherwise modify flows at Farad, as well as other flow measurement stations. In the low Q_{10} flow case, these depletions appear magnified on the once in 10-year basis, as contrasted to the average annual flow conclusions previously presented.

1. The relative impact of each JWPCP disposal alternative on low Q_{10} flow upstream of Derby Dam is largely the same for either the 288 or 406 river management criteria.

2. The quantitative effect of each JWPCP disposal alternative on low Q_{10} flows is different for the two river management criteria.

3. The low Q_{10} flow at Farad is unchanged with the 406 criteria and would range from a 22 percent increase to a 6 percent decrease with the 288 criteria for Truckee Canal disposal as compared to river disposal.

4. The low Q_{10} flow at Farad is reduced by a maximum of 11 percent to 53 percent in 1 month depending on river management criteria for land disposal as compared to river disposal.

5. The low Q_{10} flow is typically reduced by 10-20 percent with a maximum of 28 percent at Vista and Derby Dam for Truckee Canal disposal as compared to river disposal.

6. The low Q_{10} flow is typically reduced by 10-20 percent with a maximum of 65 percent at Vista and Derby Dam for land disposal as compared to river disposal.

7. The low Q_{10} flow at the inlet to Pyramid Lake is typically reduced by 2-9 percent with a maximum reduction of 15 percent for 406 criteria for Truckee Canal disposal as compared to river disposal. For 288 criteria, the low Q_{10} flow is increased in some months up to 175 percent and decreased in others by up to 16 percent for Truckee Canal disposal as compared to river disposal.

8. The low Q_{10} flow at the inlet to Pyramid Lake is typically reduced by about 5 percent with a maximum of 36 percent for 406 criteria with land disposal as compared to river disposal. For 288 criteria, the low Q_{10} flow is reduced by up to 73 percent for land disposal as compared to river disposal.

Conclusions 9 through 17 may be sensitive to the model assumption that uses Orr Ditch Decree criteria to determine Truckee Meadows agricultural diversions. The percentage changes given in conclusions 9 through 17 could be changed if other assumptions are used. These conclusions indicate that, with urban growth in the Truckee Meadows, land disposal will result in the comparatively greatest decrease in low

Q_{10} flows, with river disposal least and Truckee Canal disposal between the two. It is likely that this basic conclusion is independent of the agricultural diversion assumptions used, but that the magnitude of the percentage changes may be sensitive.

9. The low Q_{10} flow is increased up to 12 percent at Farad, although reduced by 6 percent in 1 month, under Truckee Canal disposal and 288 criteria as a result of Truckee Meadows growth. Under 406 criteria the flow is unchanged.

10. The low Q_{10} flow is increased by up to 4 percent at Farad, decreased by 2 percent in 1 month, under Truckee River disposal and 288 criteria as a result of Truckee Meadows growth. Under 406 criteria the flow is unchanged.

11. The low Q_{10} flow is increased up to 4 percent and decreased up to 5 percent under land disposal and 288 criteria due to Truckee Meadows growth. Under 406 criteria it is unchanged except for a reduction of up to 14 percent in 2 months.

12. The low Q_{10} flow is reduced by up to 12 percent at Vista and Derby Dam under Truckee Canal disposal with either 406 or 288 criteria as a result of Truckee Meadows growth.

13. The low Q_{10} flow is reduced by up to 6 percent at Vista and Derby Dam under river disposal with either 406 or 288 criteria as a result of Truckee Meadows growth.

14. The low Q_{10} flow is typically reduced by 2-10 percent, and by as much as 26 percent at Vista and Derby Dam under land disposal and 406 criteria as a result of Truckee Meadows growth. Under 288 criteria the reduction is typically 3-15 percent with a maximum of 17 percent.

15. The low Q_{10} flow is reduced by up to 9 percent at the inflow to Pyramid lake under Truckee Canal with 406 criteria as a result of Truckee Meadows growth. With 288 criteria the reduction is as high as 23 percent.

16. The low Q_{10} flow is reduced by up to 3 percent at the inflow to Pyramid Lake under river disposal with 406 criteria as a result of Truckee Meadows growth. With 288 criteria the reduction is as high as 33 percent.

17. The low Q_{10} flow is reduced by up to 16 percent at the inflow to Pyramid Lake under land disposal with 406 criteria as a result of Truckee Meadows growth. With 288 criteria the reduction is as high as 42 percent.

Tables 4-4 through 4-7 illustrate the proportionate changes that would occur under various scenarios. These figures are not intended to indicate which if any scenario would result in a specific flow, but rather that if a particular disposal option is chosen, its discrete effect will be to increase or decrease Truckee River low Q_{10} flows relative to the other JWPCP options by the proportions shown in the table.

Drought Periods. Droughts provide the most severe test of a managed river system and tend to reveal its ability to sustain beneficial uses under adverse conditions. Both M&I and agricultural deficits were examined during drought periods, which are reflected in the model's hydrologic base, to discern relative low Q10 flow differences that could be associated with the JWPCP alternatives.

During the hydrologic period simulated in the model, two droughts occurred. The first drought, in the early 1930s, lasted several years and the second, in the early 1960s, lasted about 2 years. At times during both droughts the model identified M&I and agricultural water shortages which were defined as the differences between demand and supply. The model did not attempt to simulate conditions of reduced water use during shortages but instead identified the magnitude of the shortage. Reoperation of the Truckee River model during a drought to reflect reduced consumption was not considered necessary since the magnitude of the deficit is informative about the level of conservation required to meet demands. The timing of a shortage also affects the ability of M&I water customers to conserve to meet shortages. A delivery shortage of 20 percent during August does not have the same impact as the same shortage in January. The reason is that lawn and garden irrigation, a major component of August M&I water use, is easier to reduce than indoor uses. A major question relates to how water delivery deficits may be impacted by the effluent disposal options.

Comparisons were prepared for the various scenarios and the results are shown in Table 4-8. For both the 406 and 288 criteria, the deficits associated with Truckee Canal disposal are similar in magnitude to the deficits under Truckee River disposal. The deficits that occur under the land disposal option, however, are generally in excess of those under Truckee River or canal disposal. In fact, in the case of year 2000 growth conditions with land disposal, deficits begin to occur earlier in the drought years than under Truckee Canal or river disposal options.

The variations in deficits that could be attributed to scenario differences in urbanization were also investigated in Table 4-9. It was found that M&I deficits can be expected to increase in response to urbanization. This is especially

Table 4-8. Comparison of Calculated Relative Changes in M&I Deficits in Drought Periods as a Function of JWPCP Effluent Disposal Options

(Truckee River Disposal = 100)

	1926	1929	1930	1931	1932	1933	1934	1935	1960	1961
Dodge Flat Disposal - 406 Criteria										
1985	-	-	*	-	-	*	-	-	-	-
2000	-	-	122	100	-	130	100	-	-	-
Dodge Flat Disposal - 288 Criteria										
1985	-	-	102	100	-	104	100	-	-	-
2000	*	135	103	100	114	101	100	1033	157	103
Truckee Canal Disposal - 406 Criteria										
1985	-	-	-	-	-	-	-	-	-	-
2000	-	-	97	100	0	314	100	-	-	-
Truckee Canal Disposal - 288 Criteria										
1985	-	-	100	100	-	100	100	-	-	-
2000	-	109	101	100	100	100	100	50	104	101

Footnotes:

* Deficit predicted, with no shortage for base case.
- No deficit.
Year 1985 conditions equal ESP (30 mgd)
Year 2000 conditions equal growth to year 2000 (greater than 40 mgd)

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

Table 4-9. Comparison of Calculated Relative Changes in M&I Deficits in Drought Periods as a Function of Urbanization of Truckee Meadows

(1985 [30 mgd] = 100)

	1926	1929	1930	1931	1932	1933	1934	1935	1960	1961
Year 2000 Plus (51 mgd). 406 Criteria.										
Truckee River Disposal	-	-	*	*	-	*	*	-	-	-
Dodge Flat Disposal	-	-	*	*	-	*	*	-	-	-
Truckee Canal Disposal	-	-	*	*	-	342	*	-	-	-
Year 2000 plus (51 mgd). 288 Criteria.										
Truckee River Disposal	-	*	314	1,240	*	588	429	*	*	*
Dodge Flat Disposal	*	*	315	1,240	*	570	429	*	*	*
Truckee Canal Disposal	-	*	316	1,240	*	590	429	*	*	*

Footnotes

* Shortage calculated compared to no shortage calculated for base case.
- No shortage.

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

true with respect to the 288 criteria where substantial increases in the risk of deficits are indicated between 1985 and 2000. Urbanization influences the M&I deficits equally among the Truckee River, Truckee Canal, and land disposal alternatives under the 288 criteria, suggesting that disposal option effects are independent of urbanization under the river management criteria.

Several conclusions can be reached from this analysis of drought conditions:

1. Among the disposal options, land disposal leads to the largest risk of increasing M&I deficits under drought conditions using the 288 criteria. Using the 406 criteria, the Truckee Canal disposal option increases the risk of deficit slightly over land disposal.

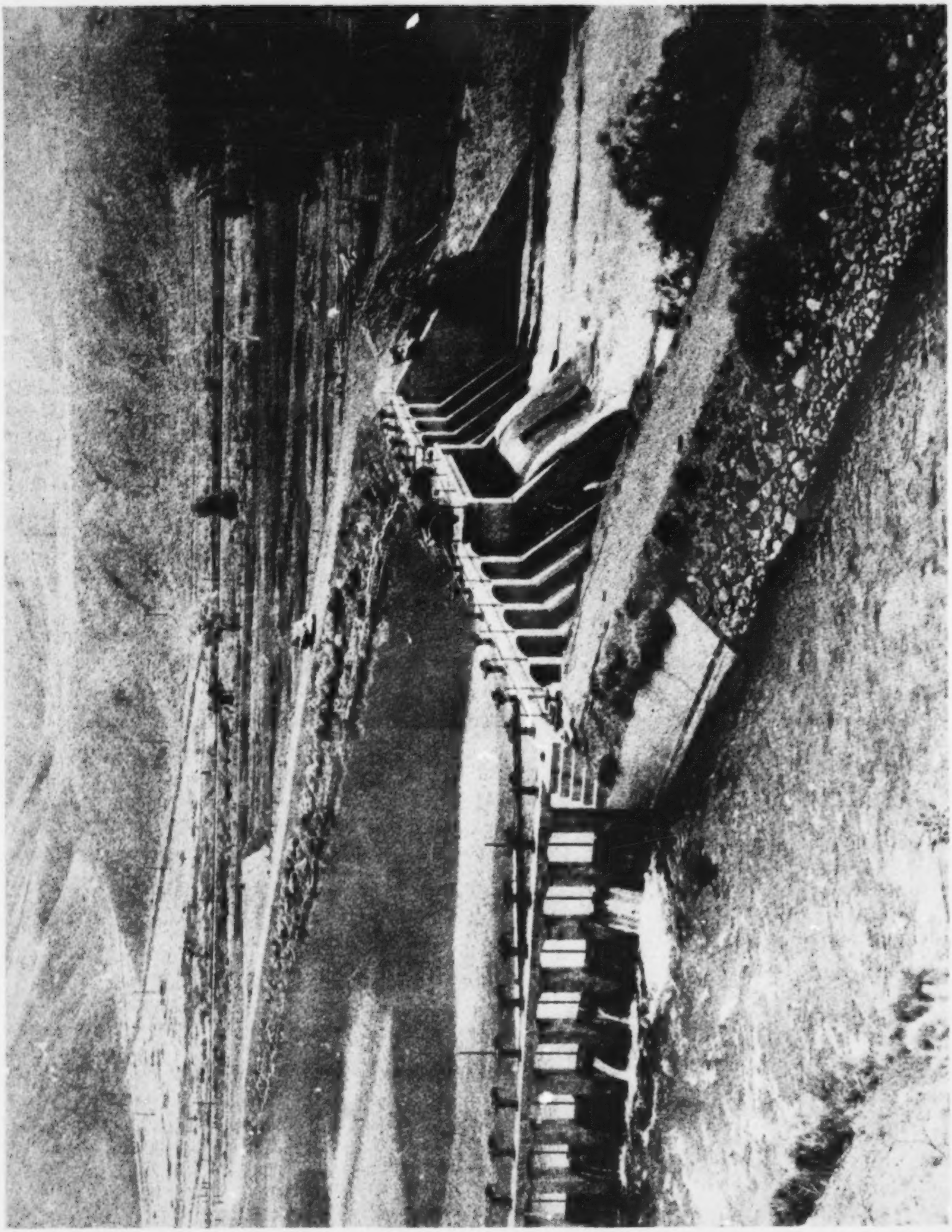
2. To prevent or minimize the risk of deficits, M&I uses would require a greater call on stored water. This issue cannot be resolved within the context of this EIS.

3. Increasing urbanization will tend to increase the risk of M&I deficits during droughts and this effect will be independent of JWPCP disposal options.

Projected agricultural deficits were examined for various scenarios and compared for each disposal option. The drought condition deficits to the Truckee Meadows, Truckee Division and Carson Division agricultural lands that occur under the land and Truckee Canal disposal alternatives were compared to Truckee River disposal. Under both 288 and 406 management criteria, the greatest agricultural deficits occur under the land disposal option. The canal disposal option shows the least amount of agricultural deficit. Deficits occur only during low flow events when the flow in the river decreases below the value of the low Q_{10} flow. Table 4-10 shows their relative magnitude.

Derby Dam Flow Split. Derby Dam may be considered the focal point of Truckee River flow. At this point, the Truckee River can be diverted into the Truckee Canal for use in the Carson Basin or allowed to flow down the natural river channel. This diversion, which has been in operation since 1905, is influenced by several criteria including TCID demand and reservoir storage. The magnitude and timing of the TCID diversion will therefore vary according to demand/storage criteria.

The division of flow at Derby Dam was analyzed for the low Q_{10} flow condition to determine quality and quantity relationships between the upper and lower river. Table 4-11 shows the flow split as a function of the flow released to



Derby Dam, Showing Truckee Canal Diversion in Left Foreground.

Table 4-10. Comparison of Calculated Relative Changes in Computed Newlands Project Shortages (Truckee Division and Carson Division). Truckee River Disposal = 100.

	Truckee River Disposal (40 mgd)	Land Disposal (40 mgd)	Truckee Canal Disposal (40 mgd)
406 Criteria	100	166	94
288 Criteria	100	171	76

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

Table 4-11. 1-in-10-Year Flow By-Passed to Below Derby Dam as a Percent of the Total Flow at Derby Dam (percent)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
406 Criteria (40 mgd, Truckee River Disposal)											
3.0	4.1	1.7	1.3	1.5	1.7	1.8	1.7	1.7	1.6	3.0	4.5
288 Criteria (40 mgd, Truckee River Disposal)											
11.1	24.4	35.7	39.3	28.1	25.6	45.2	55.3	56.3	68.3	24.7	24.9

DATA SOURCE: Jones & Stokes Associates and DRI, 1979.

the lower Truckee River at Derby Dam (the balance is diverted into the Truckee Canal). A mean monthly low Q_{10} flow below the dam is used as the basis for analyzing this flow split.

Table 4-11 shows that for the 406 criteria, a maximum of 3 percent of the low Q_{10} flow arriving at Derby Dam is released to the lower river for all months analyzed. This low percentage is to be expected during low river flows because in the river model the only water right below Derby Dam, under the 406 criteria, is the tribe's current agricultural demand of 3,500 acre-feet per year. This demand is very small in comparison to the demand along the Truckee Canal and in the Carson Division of the Newlands Project. The low Q_{10} flow condition is considered close to a worst case situation for the lower river.

If the Indian tribe were to utilize their rights to over 30,000 acre-feet per year for agricultural use, this flow division would change. The effects of this potential action are discussed later in this section.

This 1-in-10-year event yields a condition where the lower river is almost completely isolated from the influence of the upper river. If the 1-in-10-year flow past Derby Dam is compared to Pyramid Lake inflow (Table 4-12), it can be seen that the small amount released to the lower river represents less than 20 percent of the Pyramid Lake inflow for that month. The remainder of the flow into Pyramid Lake comes from accretions from the canal or agricultural return flows.

Tables 4-11 and 4-12 suggest that under 406 criteria and the Truckee River disposal option, a small percentage of the low Q_{10} flow at Derby Dam is passed to the lower Truckee River, and that amount represents only a small percentage of the Pyramid Lake inflow.

The 288 criteria utilize a fishery demand for the lower river that is much larger than the existing 3,500 acre-feet Indian agricultural demand under the 406 criteria. Because of this one expects greater low Q_{10} flows to the lower river. Fishery releases coupled with a reduced TCID demand (from 406,000 to 288,000 acre-feet per year) should produce a flow split at Derby Dam in which a larger percentage of the low flow arriving at Derby Dam is by-passed. Table 4-11 shows that this is what happens, with the percentage of the low Q_{10} flow that passes Derby Dam varying from 24-75 percent. This suggests a more active connection between the lower and upper river flows than was found with the 406 criteria. The by-passed flow, in turn, makes up a larger portion of the Pyramid Lake inflow, as compared to the 406 criteria.

Table 4-12. 1-in-10-Year Flow Below Derby Dam as a Percent of Pyramid Lake Inflow
(percent)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
406 Criteria (40 mgd, Truckee River Disposal)											
20.6	23.5	17.4	7.3	8.3	9.1	17.4	16.7	16.3	14.4	20.0	24.3
288 Criteria (40 mgd, Truckee River Disposal)											
48.0	75.9	89.3	81.6	78.1	70.6	90.9	94.3	91.1	94.0	86.3	79.9

DATA SOURCE: Jones & Stokes Associates and DRI, 1980.

By modifying demands along the Truckee River, especially demands along the lower river (the tribal irrigation and fishery demands) and the TCID demand, the flow split can be manipulated. Water quality and biotic conditions in the lower Truckee River are more clearly influenced by waste disposal options than by groundwater accretions when the percentage of flow passing the dam is substantial. The two cases considered reflect two greatly differing conditions, especially with respect to the lower river where under one case there is a large fishery flow and under the other there is essentially no fishery flow and only a comparatively small agricultural demand. Analyzing other cases will modify the flow split at Derby Dam and therefore modify the relationship between the upper and lower river in a low flow event.

In conclusion, the flow split has substantial water quality implications, as discussed in subsequent sections. The flow split is more sensitive to changes in river management criteria than to changes in effluent disposal options. The response of this flow split to effluent disposal is indicated by the Low Q_{10} flow responses in Table 4-12, which illustrate decreases in low Q_{10} flow into Pyramid Lake for land disposal and Truckee Canal disposal as compared to Truckee River disposal. The relative timing of these low Q_{10} flows is illustrated in the following review of historic low flows.

The historic 7-day low Q_{10} flow (Table 4-13) shows extremely low flows during the winter months and a maximum flow in March. The 30-day low Q_{10} flows (Table 4-14) show the same pattern. The similarity between the 7-day low Q_{10} flow and 30-day low Q_{10} flow suggests that low flow events historically tend to last for at least a month rather than being brief episodes of a few days. The small difference between the 30-day low Q_{10} flows for the entire period between July and January suggest that this low flow condition occurs over several months.

These average monthly flows of less than 10 cfs illustrate the sensitivity of the lower Truckee River to the diversion at Derby Dam. During low flow periods the lower Truckee River receives only minimal flows, a condition that can exist during much of the year in dry periods.

Recently, greater flows have been released for maintaining the fishery of the lower Truckee River and Pyramid Lake. If these flows continue the flow split at Derby Dam will respond more nearly like the 288 criteria. If only the irrigation flows are recognized, the flow split will be more nearly like the 406 criteria.

Table 4-13. Historical 7-Day Low Q_{10} Flows Below Derby Dam
(cfs)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.4	1.3	1.5	4.3	12.4	7.1	9.9	10.2	5.1	1.4	1.3	1.2

DATA SOURCE: USGS, 1979.

Table 4-14. Historical 30-Day Low Q_{10} Flows Below Derby Dam
(cfs)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2.2	*	5.2	19.1	34.7	13.8	10.0	10.5	8.7	3.1	1.7	2.1

Footnotes:

*Not computed.

DATA SOURCE: USGS, 1979.

Exercise of Tribal Water Rights. If the Indians were to exercise their full water right of over 30,000 acre-feet per year, a different baseline case for evaluation of impacts would be created. Under such conditions, consumptive losses on the river will increase by about 17,700 acre-feet per year, if the irrigation is assumed to be 67 percent efficient, with 33 percent of the water diverted under the right returning to Truckee River as agricultural return flow. (Additional diversion of 26,500 acre-feet per year x 0.67 = 17,700 acre-feet per year. Present consumptive losses are estimated at .67 x 3,500 acre-feet per year = 2,350 acre-feet per year.) If the tribal water right is used for Dodge Flat irrigation under the land disposal alternative, consumptive losses will total about 48,800 acre-feet per year, equal to the total effluent flow, since return flows will not be allowed. This assumes cessation of the present 3,500 acre-feet per year diversion in conjunction with the Dodge Flat implementation.

The depletions in water in the basin are demonstrably larger with land disposal than for other alternatives, even if the Indian water right is fully exercised. However, the effect on Truckee River flows of land disposal would be less severe, as compared to Truckee River and Truckee Canal disposal under the above conditions, than the numerical analysis of model output based on existing tribal diversions indicates. Since no scenarios were mathematically modeled for the assumption that the tribal water right would be fully exercised, no further numerical analysis is attempted.

Effect of JWPCP on Flow Management. The foregoing analyses treat the JWPCP-induced flow changes as occurring against a background of two or three different sets of river management criteria. These criteria reflect alternative basic assumptions developed in response to competing demands and complex institutional arrangements. The analyses do not attempt to predict any changes in river management that might be necessary for or precipitated by expansion of the JWPCP and changes in effluent disposal. In fact, the plant expansion, coupled with prospective changes in disposal methods, may be a catalyst for change or attempts to change certain management methods of the Truckee River system. This is discussed further in Chapter 5.

Summary of Changes in Truckee River Flows

For Truckee Canal Disposal As Compared to River Disposal.

- o Reduces mean annual flow from Vista to Derby Dam by 8 percent, no change in Pyramid Lake inflows.
- o Reduces low Q_{10} flow by up to 28 percent at Vista and Derby Dam and by up to 16 percent at Pyramid Lake inlet.
- o Increases spills from Lahontan Reservoir by about 20 percent.
- o Affects the risk of M&I deficits very little, and reduces the risk of Newlands Project deficits.

For Dodge Flat Disposal as Related to River Disposal.

- Reduces mean annual flow from Vista to Derby Dam by 8 percent, and reduces inflow to Pyramid Lake by 9 percent.
- Reduces low Q_{10} flows by up to 65 percent at Vista and Derby Dam and up to 73 percent at Pyramid Lake inlet.
- Decreases spills from Lahontan Reservoir by 2-4 percent.
- Increases the risk of M&I deficits slightly, and substantially increases the risk of Newlands Project deficits.

For River Disposal.

- Essentially no changes, except those resulting from growth as addressed following.

Changes Caused by Growth.

- From no change to 5 percent decrease inflows at Vista, depending on assumptions used in analysis. Greatest sensitivity with Truckee Canal disposal, least with river disposal.
- From no change to 4 percent decrease in inflows to Pyramid Lake, depending on assumptions. Greatest sensitivity with land disposal, least with river disposal.
- Up to a 26 percent decrease in low Q_{10} flows, depending on assumptions. Greatest reduction with land disposal.
- Substantial increased risk of M&I deficits in droughts for all alternatives.

Surface Water Quality

Introduction

The Truckee River exhibits a large change in water quality from Lake Tahoe to Pyramid Lake, a distance of about 119 miles with a 2,400-foot change in elevation. The river changes from a cold, clear, rather sterile mountain stream to a seasonally warm, turbid, lowland river. This change in character is due in part to natural processes but also from dissolved and suspended substances entering the river from human uses of land and water along the way. These substances add significantly to the observed degradation in water quality. The appropriation of water from the river exacerbates water quality degradation especially during periods of low river flow. The degredation of quality can nominally be described as excessive growth of algae on rocks, increased fish mortality, decreased fishing opportunity, concern and risks associated with swimming, and diminished aesthetic values. The state has established water quality standards and implementation and enforcement procedures to stop degradation and improve water quality in the river.

The river supports an array of uses that provide social and economic benefits to residents and visitors of the Truckee River basin. These uses are defined in state regulations as: drinking water supply, agricultural use, aquatic life, bathing and water-contact sports, wildlife propagation, boating and aesthetics, and industrial water supply. Standards specifying the water quality necessary to protect and maintain these beneficial uses have been promulgated by the State of Nevada. These standards, first established in 1967 and amended in 1973 and 1979, specify the acceptable concentrations of several constituents and conditions at regulatory control points between Farad and Pyramid Lake (Figure 4-5).

The 1979 standards are given in Table 4-15. These standards culminated from recent studies of the river, and they were adopted by the State Environmental Commission and certified by the state but have yet to receive the approval of the EPA. These approvals are in process. Implementation, monitoring and enforcement of the standards is a function of the NDEP.

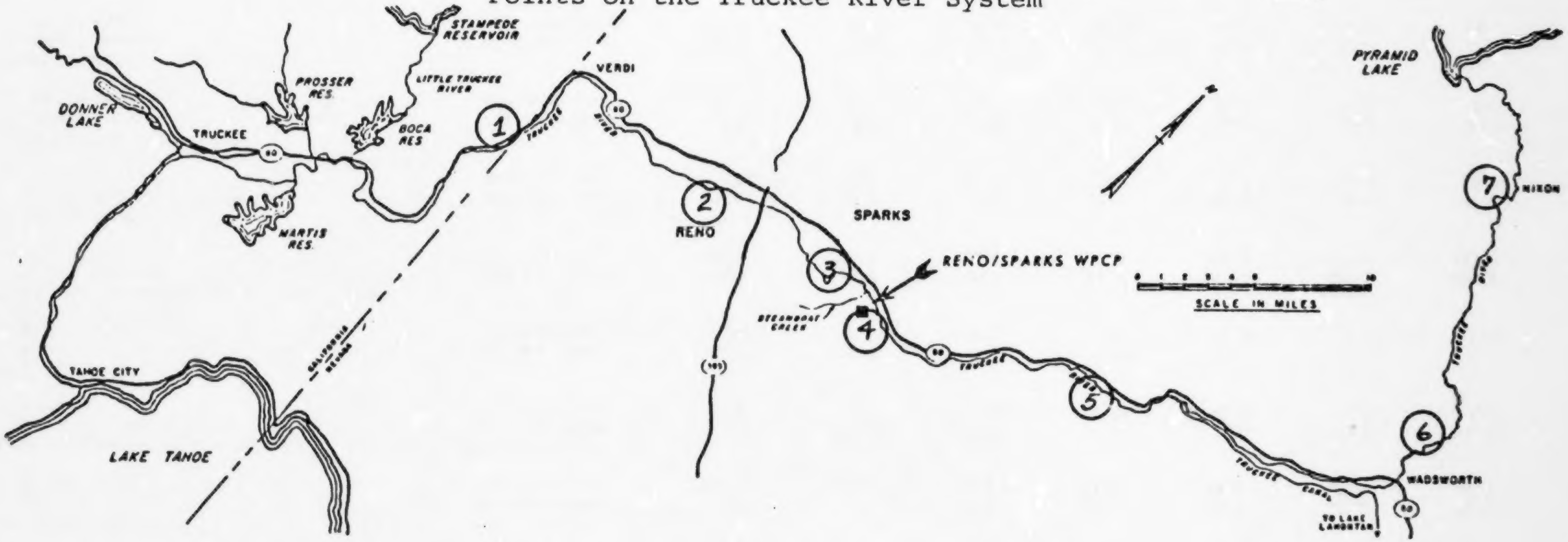
Since about 1970 there have been several studies of water quality and biota in the Truckee River (Table 4-16). EPA (1971); Kaiser Engineers (1973); NEIC (1977); McLaren (1977); SERL (1973); and others, all of which were reviewed and integrated into a later investigation done by the PEL (1979). Their study was comprehensive, including intensive field and laboratory analyses conducted in 1977 and 1978. The PEL study, prepared for the Cities of Reno and Sparks, had two principal objectives: 1) to determine the effects of the JWPCP on downstream water quality and biota and 2) to develop planning guidelines for the Master Project. The PEL report was a principal product used in the establishment of water quality standards. Table 4-17 is a composite example of water quality in the river as observed by the PEL. Because of its comprehensive excess and orientation to the Master Project the PEL study is the main data source for this EIS. Other data are used as they apply to impact analysis.

PEL Conclusions

The conclusions of the PEL (1979) study were used as a basis for the Master Project facilities planning and are presented below:

"1. The effluent discharge from the Reno-Sparks JWPCP is, together with flow, the most significant factor in water quality conditions of the lower Truckee River.

Figure 4-5. Water Quality Monitoring and Control Points on the Truckee River System



(1) Farad Water Quality Monitoring Station*
(2) Idlewild Water Quality Monitoring Station*
(3) Boynton Water Quality Monitoring Station*[1]
(4) Vista Water Quality Monitoring Station*
(5) Clark Station Water Quality Monitoring Station
(6) Ceresola Ranch Water Quality Monitoring Station*
(7) Nixon Water Quality Monitoring Station

* State Water Quality Control Points
[1] Considered the same as the McCarran Bridge control point.

SOURCE: Washoe Council of Governments, 1978b.

Table 4-15. Water Quality Standards, Truckee River, Nevada[1]

		Control Points						
		Stateline	Idlewild	McCarran Bridge	Lockwood Bridge	Clark Bridge	Ceresola Ranch	Nixon
Temperature °C								
Single Value, Mid-May - Mid-October	Not more than	20.0	22.0	23.0	23.0	26.0	25.0	30.0
Single Value, Mid-October - Mid-May	Not more than	11.0	12.0	13.0	14.0	15.0	16.0	14.0
Maximum allowable temperature increase above receiving water temperature		None	3°C not to exceed single value standards					
pH Units								
Annual Average	Within Range	7.5-7.9	7.7-8.0	7.7-8.2	7.6-8.0	7.6-8.0	7.7-8.1	7.2-8.3
Single Value	Within Range	7.2-8.3	7.4-8.3	7.4-8.4	7.5-8.2	7.5-8.2	7.5-8.3	6.7-8.8
Dissolved Oxygen - mg/l								
Annual Average - daylight	Not less than	9.4	9.7	9.8	9.0	8.5	8.4	8.4
Single Value - daylight	Not less than	7.5	7.8	7.8	6.8	5.9	6.5	6.5
Single Value	Not less than	5.0	5.0	5.0	5.0	5.0	5.0	5.0
BOD - mg/l								
Annual Average	Not more than	2.5	2.5	3.0	3.0	4.0	4.0	4.0
Single Value	Not more than	3.0	3.0	5.0	5.0	6.0	5.0	5.0
Chlorides - mg/l								
Annual Average	Not more than	7.0	7.0	7.0	18.0	18.0	18.0	69.0
Single Value	Not more than	10.0	10.0	10.0	27.0	27.0	27.0	90.0
Total Phosphates (PO_4) - mg/l								
Annual Average	Not more than	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Single Value	Not more than	0.20	0.21	0.30	0.85	0.85	0.85	0.85
Total Nitrogen (as N) - mg/l								
Annual Average	Not more than	0.30	0.30	0.30	0.75	0.75	0.75	0.75
Single Value	Not more than	0.43	0.43	0.43	1.20	1.20	1.20	1.20
Total Filterable Residue at 180°C - mg/l								
Annual Average	Not more than	70.0	80.0	90.0	160.0	165.0	220.0	260.0
Single Value	Not more than	85.0	95.0	120.0	200.0	205.0	275.0	315.0
Turbidity - NTU								
Annual Average	Not more than	5.0	6.0	7.0	11.0	11.0	11.0	49.0
Single Value	Not more than	9.0	9.0	12.0	13.0	13.0	13.0	75.0
Color - PT-CO - Units								
Annual Average	Not more than	12.0	15.0	17.0	32.0	32.0	32.0	32.0
Single Value	Not more than	18.0	25.0	28.0	50.0	50.0	50.0	50.0
Total Alkalinity - mg/l as $CACO_3$								
Annual Average	Not less than	34.0	38.0	42.0	63.0	63.0	63.0	63.0
Single Value	Not less than	27.0	30.0	31.0	35.0	35.0	35.0	35.0

Table 4-15 (cont'd.)

		Control Plants						
		Stateline	Idlewild	McCarron Bridge	Lockwood Bridge	Clark Bridge	Ceresola Ranch	Nixon
Fecal Coliform - MF/100 ml								
Annual Geometric Mean	Not more than	30.0	50.0	75.0	50.0	60.0	50.0	30.0
Single Value	Not more than	150.0	400.0	400.0	400.0	400.0	400.0	400.0
Suspended Solids - mg/l								
Annual Average	Not more than	15.0	15.0	15.0	25.0	25.0	25.0	25.0
Single Value	Not more than	20.0	20.0	20.0	50.0	50.0	50.0	50.0
Sulfate - mg/l								
Annual Average	Not more than	5.0	5.0	5.0	15.0	15.0	31.0	69.0
Single Value	Not more than	6.0	6.0	6.0	20.0	20.0	41.0	86.0

Beneficial Uses - Agricultural use, aquatic life, bathing and water contact sports, boating and aesthetics, drinking water supply, industrial water supply, wildlife propagation.

[1] Adopted by the Nevada State Environmental Commission on December 11, 1979.

Table 4-15 (cont'd.)

WATER QUALITY STANDARDS FOR TOXIC MATERIALS*
APPLICABLE TO TABLES 39 - 43.1

Ammonia Nitrogen - Un-ionized - mg/l		
Single Value	Not more than 0.016	(2)
Arsenic - mg/l		
Single Value	Not more than 0.05	(1)
Barium - mg/l		
Single Value	Not more than 1.0	(1)
Beryllium - mg/l		
Single Value	Not more than 0.011	(1)
Boron - mg/l		
Single Value	Not more than 1.0	(1)
Cadmium - mg/l		
Single Value	Not more than 0.0004	(1)
Chlorine - mg/l		
Single Value	Not more than 0.002	(1)
Chromium - mg/l		
Single Value	Not more than 0.05	(1)
Copper - mg/l		
Single Value	Not more than 0.01	(1)
Cyanide - mg/l		
Single Value	Not more than 0.005	(1)
Fluoride - mg/l		
Single Value	Not more than 1.8	(3)
Iron - mg/l		
Sample Mean.	Not more than 0.3	(1)
Single Value	Not more than 1.0	(1)
Lead - mg/l		
Single Value	Not more than 0.05	(1)
Manganese - mg/l		
Sample Mean.	Not more than 0.05	(1)
Single Value	Not more than 0.20	(1)
Mercury - mg/l		
Single Value	Not more than 0.00005	(1)
Nickel - mg/l		
Single Value	Not more than 0.1	(1)
Nitrate Nitrogen - mg/l		
Single Value	Not more than 2.0	(2)
Nitrite Nitrogen - mg/l		
Single Value	Not more than 0.039	(2)
Phenolics - mg/l		
Single Value	Not more than 0.001	(1)
Phthalate Esters - mg/l		
Single Value	Not more than 0.003	(1)
Polychlorinated Biphenyls - mg/l		
Single Value	Not more than 0.000001	(1)
Selenium - mg/l		
Single Value	Not more than 0.01	(1)
Silver - mg/l		
Single Value	Not more than 0.05	(1)

Table 4-15 (cont'd)
(TOXIC MATERIALS* continued)

Sulfide - Undissociated - mg/l Single Value	Not more than 0.002	(1)
Zinc - mg/l Single Value	Not more than 0.0009	(2)
Pesticides		
Aldrin - mg/l Single Value	Not more than 0.000003	(1)
Chlordane - mg/l Single Value	Not more than 0.00001	(1)
DDT - mg/l Single Value	Not more than 0.000001	(1)
Demeton - mg/l Single Value	Not more than 0.0001	(1)
Dieldrin - mg/l Single Value	Not more than 0.000003	(1)
Endosulfan - mg/l Single Value	Not more than 0.000003	(1)
Endrin - mg/l Single Value	Not more than 0.000004	(1)
Guthion - mg/l Single Value	Not more than 0.00001	(1)
Heptachlor - mg/l Single Value	Not more than 0.000001	(1)
Lindane - mg/l Single Value	Not more than 0.00001	(1)
Malathion - mg/l Single Value	Not more than 0.0001	(1)
Methoxychlor - mg/l Single Value	Not more than 0.00003	(1)
Mirex - mg/l Single Value	Not more than 0.000001	(1)
Parathion - mg/l Single Value	Not more than 0.00004	(1)
2,4-D - mg/l Single Value	Not more than 0.1	(1)
Silvex - mg/l Single Value	Not more than 0.01	(1)
Toxaphene - mg/l Single Value	Not more than 0.000005	(1)

*These Standards are to be applied to the dissolved component in the water column.

(1.) Environmental Protection Agency, 1976, Quality Criteria for Water (The Red Book). EPA-440/9-76-023. Office of Water and Hazardous Materials, U.S. Environmental Protection Agency, Washington, D.C.

(2.) Pacific Environmental Laboratory, 1979. Effects of the Reno-Sparks Joint Water Pollution Control Plant on Water Quality of the Truckee River. Cities of Reno and Sparks, Pacific Environmental Laboratory, San Francisco, California.

(3.) State of Nevada, 1977. Water Supply Regulation, Part I. Water Quality Standards, Monitoring, Record Keeping and Reporting. State Board of Health. Carson City, Nevada.

Table 4-16

WATER QUALITY STUDIES OF THE TRUCKEE RIVER

Sponsor	Author	Program	Date
State of Nevada	Desert Research Institute	Water quality standards monitoring	1968-Date
State of Nevada	Nevada Division of Environmental Protection	Water quality standards monitoring	1966-Date
U. S. Geological Survey	U. S. Geological Survey	Water supply data	1964-Date
Reno-Sparks Joint Water Pollution Control Plant	Reno-Sparks Joint Water Pollution Control Plant	Monitoring of effluent	1967-Date
U. S. Environmental Protection Agency	U. S. Environmental Protection Agency	Water quality monitoring	Aug-Sept 1968 Mar-Apr 1977 Nov 1976
U. S. Public Health Service	U. S. Public Health Service	Water quality monitoring	1962, 1963
California Regional Water Quality Control Board	Kaiser Engineers	TTSA Project	Jul-Oct 1972
Washoe County 208 Program	URS Company		Jun-Sept 1977
U. S. Fish and Wildlife Service	U. S. Fish and Wildlife Service	Endangered, threatened species	Periodic since 1972
Dart Industries	McLaren Engineers	Upper basin law suits	Jul-Nov 1976
Reno and Sparks, EPA	Pacific Environmental Laboratories	Effect of JWPCP on river	1977-78

Table 4-17. Truckee River Water Quality Conditions
Annual Average - October 1977 to August 1978

CHARACTERISTIC	UNITS	VERDI	ABOVE STEAMBOAT CREEK	RENO/SPARKS JWPCP	VISTA	CLARK	TRUCKEE-CARSON CANAL	WADSWORTH	MARBLE BLUFF	PORTION AT MARBLE BLUFF COMPARED TO CLARK CONC. %	MER(1) %
Flow	CFS	455	420	30	455	455	345	120	120	26	26
pH	-	7.6	7.8	7.55	7.75	7.75	7.80	8.05	8.50	-	-
Temperature	°C	9.2	11.2	18.4	13.0	13.0	13.0	13.5	13.5	104	-
Turbidity	JTU	2.6	8.0	9.6	9.9	10.2	14.7	4.9	9.3	91	-
Settleable Solids	ML/L	<0.1	<0.1	0.28	<0.1	0.1	0.1	<0.1	<0.1	-	-
Suspended Solids	MG/L	6.3	25	20.3	23	30	59	13.7	18.0	60	16
Dissolved Solids	MG/L	86	128	315	180	184	186	169	401	218	57
B.O.D.(5)	MG/L	<1.0	1.8	14.8	6.0	3.7	2.7	1.8	2.2	59	15
T.O.C.	MG/L	4.7	6.4	20.6	7.5	7.9	8.1	5.6	6.2	78	20
Ortho-Phosphate(P)	MG/L	0.01	0.02	5.40	0.83	0.76	0.71	0.20	0.06	8	2
Phosphate(TP)	MG/L	0.04	0.05	5.75	0.91	0.91	0.91	0.26	0.19	21	5
Nitrogen(TN)	MG/L	1.4	1.2	21.3	4.8	4.2	3.8	1.8	1.65	39	10
Nitrate(N)	MG/L	0.21	0.2	0.9	0.37	1.58	1.72	0.31	0.07	4	1
Nitrite(N)	MG/L	0.01	<0.01	2.7	0.16	0.13	0.11	0.02	<0.01	<10	<2
Ammonia(N)	MG/L	0.06	0.06	14.8	2.9	1.00	0.43	0.10	0.06	6	2
Unionized Ammonia(N)	MG/L	<0.005	<0.005	0.20	0.047	0.039	0.009	<0.005	0.005	13	3
Calcium	MG/L	11.6	18	25.5	20	22.7	22.7	24.0	41.5	183	48
Magnesium	MG/L	4.1	6.8	8.1	7.3	8.3	8.5	8.8	17.6	212	55
Sodium	MG/L	7.1	12.1	61.7	26.8	27.8	28.2	24.1	74.3	267	69
Potassium	MG/L	1.9	2.5	12.5	5.0	5.2	5.3	4.2	7.2	138	36
Iron	MG/L	0.44	0.6	0.42	0.87	0.94	1.35	0.41	0.64	147	38
Manganese	MG/L	0.06	0.05	0.05	0.06	0.07	0.07	0.05	0.10	143	37
Alkalinity($CaCO_3$)	MG/L	48	75	153	94	91	88	99	110	121	31
Chloride	MG/L	6.3	8.2	40	20.5	19.3	20	16	95.3	494	128
Sulfate	MG/L	3.0	16.8	55	23.3	26.1	26.5	20.9	86.3	331	86
Arsenic	µG/L	<10	<10	<10	18	17	18	15	13	76	20
Cadmium	µG/L	<2	<2	<2	<2	<2	<2	<2	<2	-	<25
Chromium	µG/L	3.5	4	9	4	4	5	3.5	3.6	90	23
Copper	µG/L	<10	<10	10	<10	<10	<10	<10	<10	-	<25
Lead	µG/L	<10	<10	14	<10	<10	<10	<10	<10	-	<25
Mercury	µG/L	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<25
Nickel	µG/L	<10	<10	13	<10	<10	<10	<10	<10	-	<25
Silver	µG/L	<10	<10	<10	<10	<10	<10	<10	<10	-	<25
Zinc	µG/L	24	18	71	26	31	26	32	30	97	25
Dissolved Oxygen	MG/L	9.32	8.58	6.75	8.14	8.48	8.71	8.74	9.38	-	-
Dissolved Oxygun	% Saturation	94.7	89.6	82.6	87.3	89.0	94.3	95.4	102.0	-	-

(1) Mass Emission Rate (Annual)

SOURCE: Pacific Environmental Laboratories, 1979.

"2. The present water quality conditions of the lower Truckee River are not suitable for the desirable habitat of the endangered and threatened fish species - cui-ui lakesucker, and Lahontan cutthroat trout.

"3. Toxic substances in the Reno-Sparks JWPCP inhibit the fish habitat. These are by order of concern:

1) Residual chlorine
2) Ammonia nitrogen
3) Nitrite nitrogen
4) Nitrate nitrogen
5) Zinc

"4. The concentrations of these toxicants must be reduced below threshold levels for the unrestrictive fish habitat to reestablish in the Truckee River.

"5. Dissolved oxygen depressions occur in the Truckee River that produce barely tolerable conditions for trout and other cold water species in diurnal cycles that occur during late night and early morning hours.

"6. The primary factor in the periodic low dissolved oxygen concentration is the nutrient (nitrogen and phosphate) compounds in the effluent discharge from the Reno-Sparks JWPCP.

"7. The biochemical oxygen demand of the Reno-Sparks JWPCP is primarily a nitrogenous BOD. This causes an oxygen sag on the order of 1.5 mg/l in the immediate downstream reach of the Truckee River above Derby Dam, is attributable to nitrifying bacteria in the periphyton of the river bottom, but is far less significant in overall dissolved oxygen depression than periphyton nutrient stimulation.

"8. Benthic macroinvertebrates are in a "polluted" classification downstream of the Reno-Sparks JWPCP discharge, recover substantially by Derby Dam and become increasingly similar to the upstream communities of bottom dwelling organisms at Nixon.

"9. The limiting nutrient in the Truckee River at the present conditions of treatment and discharge of the Reno-Sparks JWPCP is nitrogen. However, the current installation of phosphorus removal treatment by the "early start" program will make phosphorus the limiting nutrient and should provide substantial enhancement of river water quality.

"10. The nutrient discharges into Pyramid Lake and Lahontan Reservoir are significantly less than in the river at Derby Dam. The nitrogen and phosphorus loading into Pyramid Lake is in the range of 5-10 percent, and for Lahontan Reservoir is in the range of 40-60 percent of the annual load in the Truckee River above Derby Dam. The nutrient loadings to the terminal lakes from the Truckee River are significantly less than that from other sources.

"11. Low flow conditions in the Truckee River, particularly in the reach below Derby Dam, create excessively high temperature conditions for trout during summer periods.

"12. River management and low flow augmentation will be required for the Reno-Sparks JWPCP to expand to a 40 mgd capacity and continue to discharge to the Truckee River in relation to economically practicable treatment.

"13. A flow to provide a minimum 1:1 effluent/river dilution during late summer flow conditions is desirable and can be provided by storage and release of approximately 10,000 acre-feet from upstream reservoirs.

"14. Approximately this same 10,000 acre-foot volume of storage will be needed to provide low flow augmentation of the Truckee River below Derby Dam in the event the discharge from the Reno-Sparks JWPCP is changed from the river to land.

"15. Objectives for river water quality considering economically practicable degrees of treatment of the Reno-Sparks JWPCP are proposed on the basis of reducing toxicants below threshold levels, reducing oxygen consuming compounds by two-thirds, phosphorus by 85 percent, and nitrogen compounds by half.

"16. A change in the point of discharge from Steamboat Creek to split discharges of equal portions, one on the south bank of the river immediately below the confluence with Steamboat Creek and the other immediately below the Vista Reef for the anticipated 40 mgd flow, will provide a clear zone for fish passage around the immediate effluent mixing zone for temperature and pH, and remove the present blockage at the mouth of Steamboat Creek and across the Truckee River.

"17. The degree of treatment desirable to provide substantial river water quality enhancement and to accommodate a flow of 40 mgd will require full secondary treatment with nitrification, phosphorus removal and effluent polishing. The total nitrogen concentration should be reduced to 5 mg/l and the effluent will require reliable chlorination and dechlorination to produce effective bacterial and virus removal and no residual chlorine. The existing treatment facility and "PhoStrip process of the early start program" can be effective components of the necessary facilities.

"18. Not withstanding all practical improvements of the Reno-Sparks JWPCP and effluent, there remain doubts as to the satisfactory habitat for spawning and growth of Lahontan cutthroat trout in the river below Derby Dam due to high temperatures related in part to diversions and low flow conditions. This is a corollary problem that better river flow and storage management may be able to resolve, but was beyond the scope of this investigation".

Methodology

PEL data are used for most purposes in the EIS analyses since that study was an integral part of the facilities planning effort for the JWPCP. The PEL data do exhibit limitations, however, since they were obtained during a drought (relatively dry period). To the extent that dry period flows represent a more severe condition on the Truckee River, i.e., less dilution for the base load of pollutants, the PEL data may indicate the more conservative or worst case type conclusions.

The DRI data are used in a few instances in Appendix F because they also include flows tributary to the Truckee River from the North Truckee Drain. These data allow a more complete depiction of relative flows into the Truckee Meadows. Other data sources are referenced as appropriate.

As in most other Truckee River studies and data summaries, the PEL segmented the river into reaches. Typically the reaches identified are nearly the same or composites of individual segemtns. The commonly used boundaries for segments are shown in Figure 1-1. In the case of this EIS the following segmentation is typically used although variances occur when needed to explain data or conditions:

Lake Tahoe to Stateline
Stateline to above Steamboat Creek
Steamboat Creek to Vista
Vista to Derby Dam
Derby Dam to Pyramid Lake
Pyramid Lake
Truckee Canal
Lahontan Reservoir

Quite often water flow and quality data are derived from intermediate points, such as Clark and Wadsworth. The selection of reaches tends to encompass the major features and processes in the river. The affected environment is discussed in fully by river segment in Appendix F.

The methodology used in analyzing the water quality conditions and impacts on the Truckee River of necessity involve a number of simplifying assumptions. Tools, such as a verified water quality model, are not available. During the course of their studies, PEL proposed to develop a computer-based quality model for the Truckee River; however, EPA funding for that effort was not forthcoming. Further, it is doubtful that adequate data exist to properly calibrate such a model. Thus projections have been based on appropriate simplifying assumptions.

Pollutant loading in the Truckee River tends to fluctuate considerably, often independently of flow. WCOG (1980a, pers. comm.) attempted to correlate the background nitrogen loading to flow, and demonstrated a very poor correlation. For purposes of analysis in this EIS, the background loading for each constituent was taken to be an average constant daily value. In other words, a certain average background load of each constituent would be present in the Truckee River each day regardless of flow, and the resulting concentration of each constituent would be determined by dividing the load by the flow.

The existing background values were estimated by summing averages of PEL quality data on the Truckee River upstream of Steamboat Creek with the load in Steamboat Creek above the JWPCP inflow. Where appropriate, the current JWPCP discharge load was estimated from PEL data also.

Future background levels of various constituents in the Truckee River are affected by a wide range of variables, most of which are separate from the proposed JWPCP expansion. Increased human habitation and consumptive pressures on water supply will tend to increase background loads. Efforts by EPA, WCOG, and others (described later in this section) will tend to mitigate or reduce existing and potential sources of pollutants. The balance that will be struck between these actions is not possible to quantify given present knowledge. For this reason, it is assumed in this EIS that background loading will remain the same into the future. It is certainly EPA's desire that background loading decrease, but the JWPCP plant and decisions related to its expansion do not give direct opportunities for the mitigation of nonpoint source pollutants.

Future pollutant loading for the ESP (30 mgd) was based on background load estimates developed from PEL data and effluent load data from Kennedy-Jenks (1980). Concentrations were determined from hydrologic model output under 1985 conditions for both the 288 and 406 criteria. Future pollutant loading from the expanded (40 mgd) JWPCP was based on the Draft Facilities Plan (Kennedy Engineers, 1980).

In stream systems having elevated nutrient levels, such as the Truckee River, biological and chemical activity converts nutrients from one form to another, while supporting an abundant aquatic flora and fauna. Ammonia and nitrite also are gradually converted to the nitrate form of nitrogen. Nitrogen and phosphorus will be taken up by aquatic life to be released later back to the stream and recycled again. Flood flows scour the stream and move substances farther downstream. Very little quantification of these processes is available for the Truckee River. However, the total mass of nutrients tends to act conservatively, and it is assumed that on an annual basis the same quantities placed in the river will eventually reach Lahontan Reservoir, Pyramid Lake, or an intermediate consumptive use. These assumptions are further explained as follows:

1. Total nutrients move almost conservatively although it is recognized that small amounts are lost from the system. Studies have been conducted regarding the algal stimulatory ability of Truckee River water; however, studies have not been conducted regarding nutrient budgets, nutrient uptake rates, or nutrient cycling in the river. The assumption that nutrients move almost conservatively is reasonable for long-term averages, but not for individual months. This situation may introduce inaccuracies when estimating the division of the nutrient load at Derby Dam.

2. Pollutant loads arriving at Derby Dam are divided according to flow. Conservation of mass is applied to the pollutant load at Derby Dam. A portion of this load goes to the Truckee Canal, and a portion to Pyramid Lake.

3. Pollutant loads contained in the seepage from the Truckee Canal move to the river conservatively (without loss). A portion of the Truckee River flow diverted into the Truckee Canal at Derby Dam seeps back to the river in the reach where the canal parallels the river. Due to lack of information regarding soil uptake or, conversely, material leached from the soil, this assumption was used. In reality, soil and vegetation take-up of water and solutes does occur. This is especially true in regard to nutrients. This assumption of course provides an overestimation of nutrient accretion from the canal to the river. It is, however,

equivalent to the direct spillback of canal water. Due to the saline nature of the soils, this assumption may underestimate salts and chlorides.

These assumptions are embodied in the ensuing analyses, which are presented on a reach-by-reach basis for the Truckee River, with separate discussion for Pyramid Lake, the Truckee Canal, and Lahontan Reservoir. Each section discusses the present water quality, the quality expected to exist when the ESP is discharging at design levels (30 mgd). Chapter 5 then presents the impacts of the JWPCP expansion to 40 mgd, including water quality implications.

Lake Tahoe to Stateline

Flows in the reach of river upstream of Farad are heavily influenced by several storage reservoirs operated to meet Floriston rate requirements. Before 1973, four wastewater treatment plants indirectly discharged treated sewage effluent to the river. These discharges had localized enrichment effects on the river and cumulative nutrient addition effects that extended for the length of the river. Consolidation of all sewage treatment into the Tahoe-Truckee Sanitation Agency (TTSA) reduced nutrients and other potential pollutants from entering the river through subsurface water accretions (EPA, 1973). There is no evidence of significantly adverse water quality problems in the river above the California-Nevada stateline, and to date the TTSA wastewater treatment plant is considered an optimum level of treatment for wastewaters generated and disposed of in the Tahoe-Truckee area.

The State of California prohibits the direct discharge of sewage effluent or other pollutants to the Truckee River. Consequently, the TTSA employs land disposal of treated sewage effluent. Nonpoint source pollution to the Truckee River does occur, however, due primarily to past and present sewage disposal practices.

In the Lake Tahoe to Stateline reach, increases in some wastewater effluent constituents have been detected below springs downslope from areas formerly used for land disposal of secondarily treated wastewater. These springs, which contain leachate from the land disposal areas, were found to contain elevated concentrations of nitrogen (Lahontan Regional Water Quality Control Board [RWQCB], 1979). Appreciable increases of nitrate concentrations were found in Truckee River water below the Cinder Cone spring, which contains leachate from the effluent of a former land disposal area (Lahontan RWQCB, 1979). Indirect, or nonpoint discharge from wastewater treatment systems represents the largest single load of nutrients to the Truckee River in this reach.

The majority of nitrogen entering the Truckee River from groundwater accretions is in the form of nitrate. The Lahontan RWQCB (1979) estimated the nitrate influx for the Cinder Cone Spring, Alpine Springs County Water District, Squaw Valley County Water District, and Tahoe Sanitation District, all of which were replaced by the TTSA plant, to be 121, 55, 22, and 137 lbs/day, respectively. These loads will diminish with time.

The Lahontan RWQCB (1979) inventoried existing septic tanks along the Lake Tahoe to Stateline reach, and found 1,514 single-family dwelling equivalents. Nitrate loading from these sources was estimated at 0.08 lbs/day per unit.

Urban runoff in this reach of the river was found to contribute less nitrate than subsurface inputs (Lahontan RWQCB, 1979). Nitrate contributions from this source may be expected to grow in relative importance as urbanization in the Tahoe basin continues.

Water quality standards for this reach of the Truckee River are expected to change. California's Lahontan RWQCB (1980) has recommended changes in the standards at certain locations of the river from those outlined in the Basin Plan and the Basin Plan update (California State Water Resources Control Board, 1975; Lahontan RWQCB, 1979). Under the proposed revisions, the total nitrogen standard at Stateline would remain as it is in the Basin Plan (0.4 mg-N/l). Total phosphorus standards would be changed from 0.02 mg-P/l to 0.5 mg-P/l for Stateline. The Lahontan RWQCB (1980) also recommended a nitrate nitrogen (NO_3-N) standard of 0.08 mg-N/l and a Total Kjeldahl Nitrogen (TKN) standard of 0.32 mg-N/l for Stateline. Neither NO_3-N nor TKN standards were included in the original Basin Plan standards. The major proposed changes in the standards were for locations upstream of Farad.

It should be noted that nitrogen loading to the Truckee River from the TTSA wastewater treatment plant is expected to increase in the future. While the 0.4 mg/l total nitrogen standard at Stateline will likely still be met, the total nitrogen load past Farad will increase over historical levels. This may adversely affect Nevada's ability to meet standards in the Nevada portion of the Truckee River.

Stateline to Steamboat Creek

This segment extends from the Farad gage to above Steamboat Creek and the North Truckee Drain, but below McCarran Boulevard.

The beneficial uses in this reach are those previously listed, with the principal uses being drinking water supply, agricultural use, aquatic life, and water contact sports. Fishing is an intensive use, as described in the recreation section. Bathing, wading and drift boating are other instream recreational uses. The aesthetics of using riparian parks are also important.

Although large amounts of water are diverted from this reach, the average flows past Reno have been sufficient to support beneficial uses. During low flow and drought years, late summer flows may be 25 percent or less of the average flow. During wet weather, river flows may be augmented by storm runoff from both urban and open lands. The hydrology of this reach is typified in a previous section.

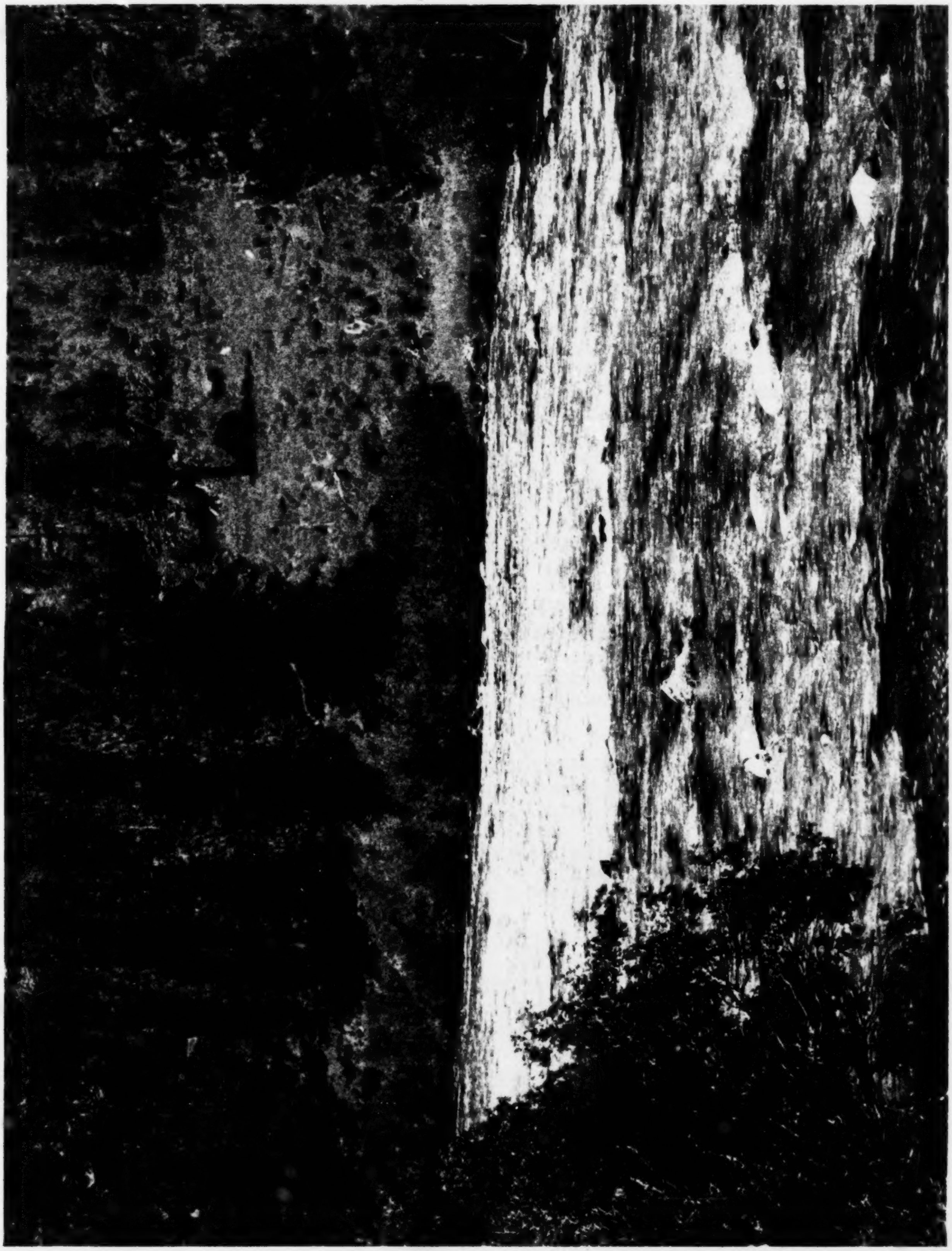
Potential pollutants enter this reach from upstream, tributaries, agricultural return, urban runoff, groundwater accretion, and possibly from unclassified urban drains. WCOG (1978b) identified many of the industrial dischargers in this reach. Permits for these discharges have been issued by the NDEP. The river at Reno carries a larger load of dissolved substances than it does at Farad or Verdi.

In this reach, temperature increases due to the warmer climate at lower elevations, decreasing river flow, removal of riparian vegetation as part of flood control work, and heat input with agricultural return flows.

Chlorophyll a measurements, an indicator of periphyton and biomass, reflect a definite increase in primary productivity between Verdi and immediately above Steamboat Creek (PEL, 1979). However, species diversity of algae varies little between these two stations, which may indicate that enrichment is not excessive.

A previous study of macroinvertebrate species composition indicated dramatic changes between Verdi and Steamboat Creek (PEL, 1979). Organisms intolerant of organic enrichment were found at Verdi. In contrast, only two of seven intolerant species sampled at Verdi were found immediately above Steamboat Creek (PEL, 1979). Further downstream at Nixon, species composition of macroinvertebrates more closely resembled species sampled at Verdi than immediately above Steamboat Creek. These data indicate two important aspects of Truckee River water quality: 1) water quality degradation occurs as the river flows through Truckee Meadows due to human activities, and 2) through natural waste assimilative processes, water quality improves somewhat by the time the flow reaches Nixon.

The Truckee River receives nonpoint source pollution between Stateline and Steamboat Creek from urban runoff, land disposal of sewage effluent and a small amount of agricultural runoff. Numerous sources of nitrogen and phosphorus pollution have been identified along this reach (WCOG, 1980b, pers. comm.):



Truckee River below Truckee.

- Verdi septic tank/leachfield systems
- Mayberry septic tank/leachfield systems
- Glen Meadows secondary treatment facility with land disposal
- Boomtown secondary treatment facility with land disposal

The Boomtown and Glen Meadows wastewater treatment plants employ land discharge. Although the degree of nutrient loading to the Truckee River has not been quantified, it is likely that leachate from these land disposal systems contributes to the nutrient loading of the river due to their close proximity to the river. Septic tank/leachfield systems upstream of Reno likely add to the nutrient load in the river.

A small amount of agricultural runoff enters the Truckee River along this reach. Urban land uses are expected to displace agriculture in the Lawton-Verdi area by the year 2000. Accordingly, agricultural return flows are expected to decline as urbanization occurs.

Urban runoff also enters the river along this reach from areas tributary to the Truckee River, including Interstate 80. A discussion of the magnitude and timing of these pollutant inputs to the river is presented later in this section.

Formerly, sludge from the Idlewild wastewater treatment facility was periodically discharged to the Truckee River (Crowe, pers. comm.). Sudden surges of nutrient loading resulted due to this practice. Land disposal of sludge is currently employed.

Operation of the Helms gravel pit also contributes to nutrient loading of the Truckee River, especially nitrate. The pit is constantly pumped to control groundwater levels. Approximately 10 cfs is pumped into the North Truckee Drain, which enters the Truckee River upstream of Steamboat Creek.

Nonpoint and point source pollutants in this reach adversely affect water quality, and make it more difficult to meet water quality standards downstream of Reno. Implementation of additional controls on these nonpoint sources of pollution will act to improve water quality. Increased human use and the proposed change in standards for the California portion of the Truckee River may partially counteract any downstream improvements. In the absence of an accurate nutrient budget model for the river, the magnitude of wasteloading conditions is largely speculative.

Total Nitrogen and Total Phosphorus. Concentrations of total nitrogen and phosphorus as measured by the PEL (1979) are depicted in Figure 4-6.

Nitrate (NO_3). In general, PEL found NO_3-N concentrations less than 0.5 mg/l upstream of the JWPCP discharge (Figure 4-7). Below Steamboat Creek, nitrate concentrations increase as ammonia (NH_4) and nitrite (NO_2) are oxidized to nitrate. NO_3 concentrations may exceed 2 mg/l (Figure 4-7), which is the state standard for toxicity.

Current NO_3-N concentrations of JWPCP effluent, as measured by PEL, average 0.9 mg/l. The facilities plan proposes in the future to increase the NO_3-N limit for river discharge from the JWPCP to a daily maximum of 4.0 mg/l. This represents an eight-fold increase in NO_3-N loading compared to existing conditions if river disposal is employed (0.9 mg/l at 20 mgd compared to 4.0 mg/l at 40 mgd).

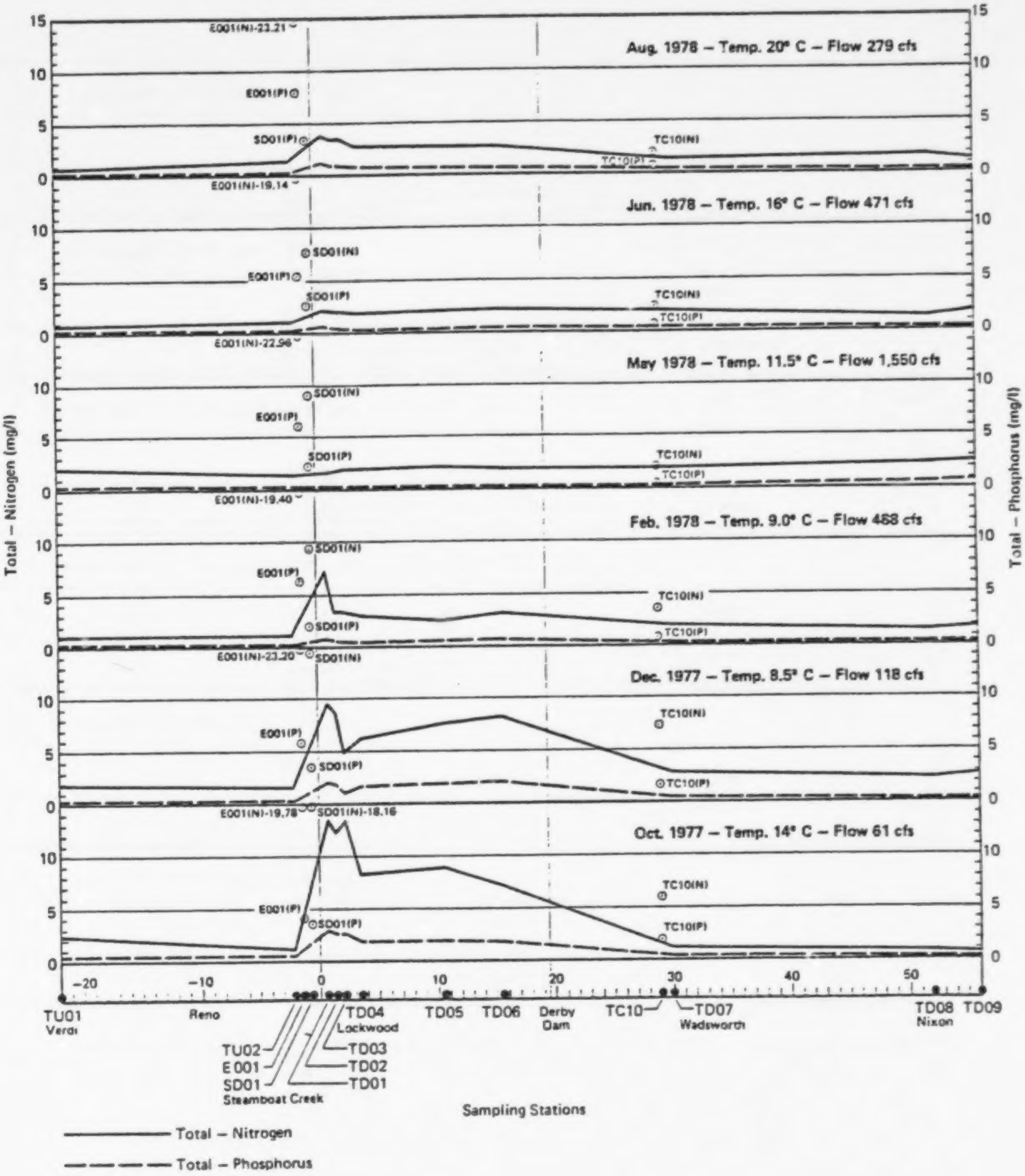
Nitrate is readily utilized by algae for growth. Algal growth in response to nutrient enrichment currently occurs along most of the river below the JWPCP. PEL measured a decrease in periphyton from above to below the JWPCP (Figure 4-8). The lower biomass and abundance is due to toxic conditions immediately below the outfall. At Vista, biomass and abundance begins to increase in response to available nutrients, including nitrate.

Under the ESP, the average total nitrogen concentration in the effluent will be 21.5 mg/l. This corresponds to an annual average loading of 8,663 lbs/day, in the river, representing an increase from the existing loading on an annual average basis.

Orthophosphate. Concentrations of orthophosphate increase significantly below Steamboat Creek as a result of discharges from the JWPCP (Figure 4-9). Orthophosphate phosphorus (O-PO_4-P) concentrations of the JWPCP effluent averaged 5.4 mg/l, as measured by PEL under existing conditions. Upon completion of the ESP, orthophosphate concentrations are projected to decrease to 0.4 mg/l. This represents nearly a seven-fold decrease in PO_4-P loading compared to existing conditions if river disposal is employed.

Total Dissolved Solids. Total dissolved solids (TDS) concentrations generally increase in a downstream direction. (Figure 4-10). Contributions to the increased concentrations of TDS include the JWPCP effluent, agricultural return flows, urban runoff, and groundwater accretions.

Figure 4-6. Total Nitrogen and Total Phosphorus Measured in the Truckee River in 1977-1978



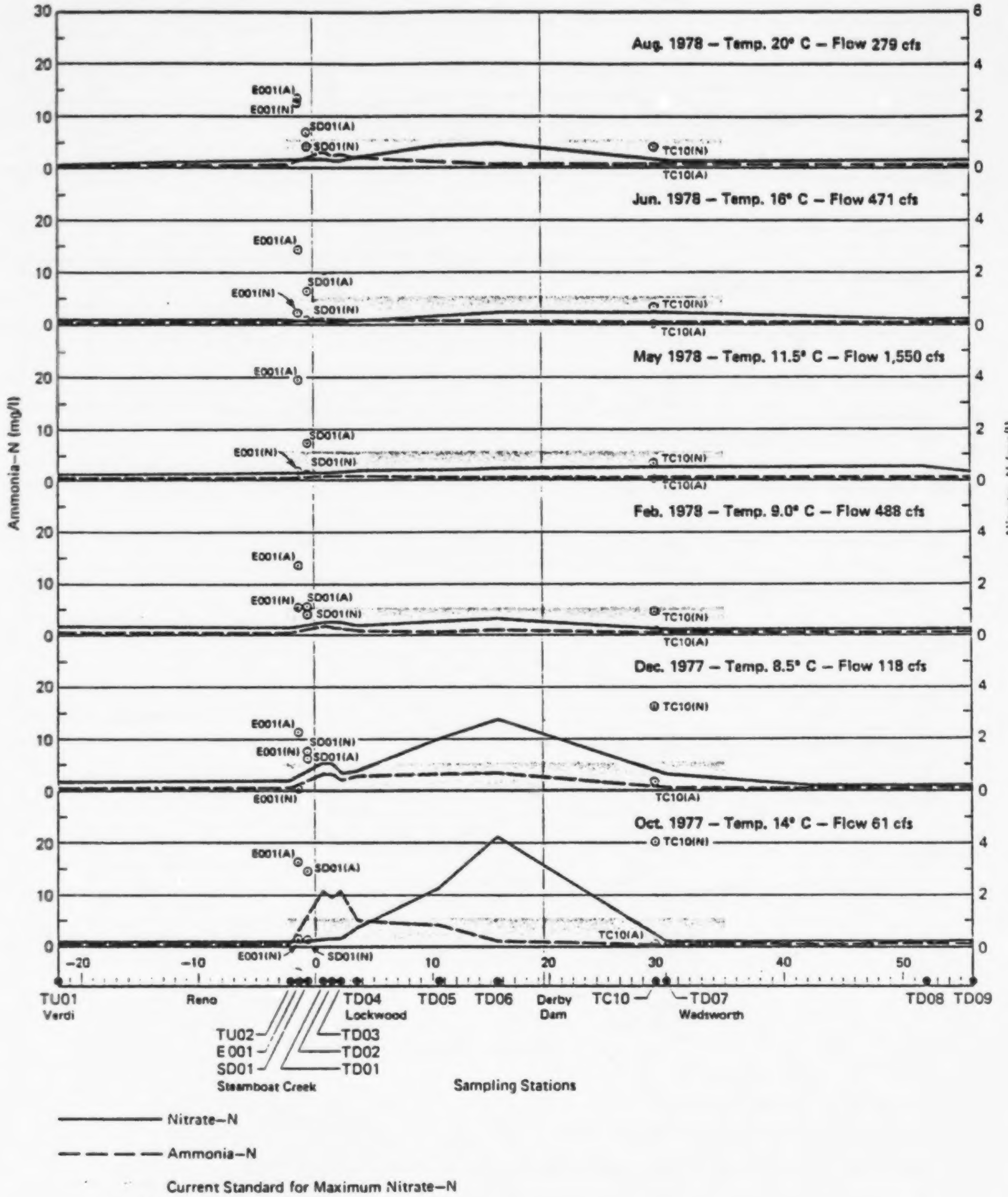
⊙ Sampling Stations not located on Truckee River.

Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratory, 1979.

Figure 4-7. Ammonia-N and Nitrate-N Measured in the Truckee River in 1977-1978



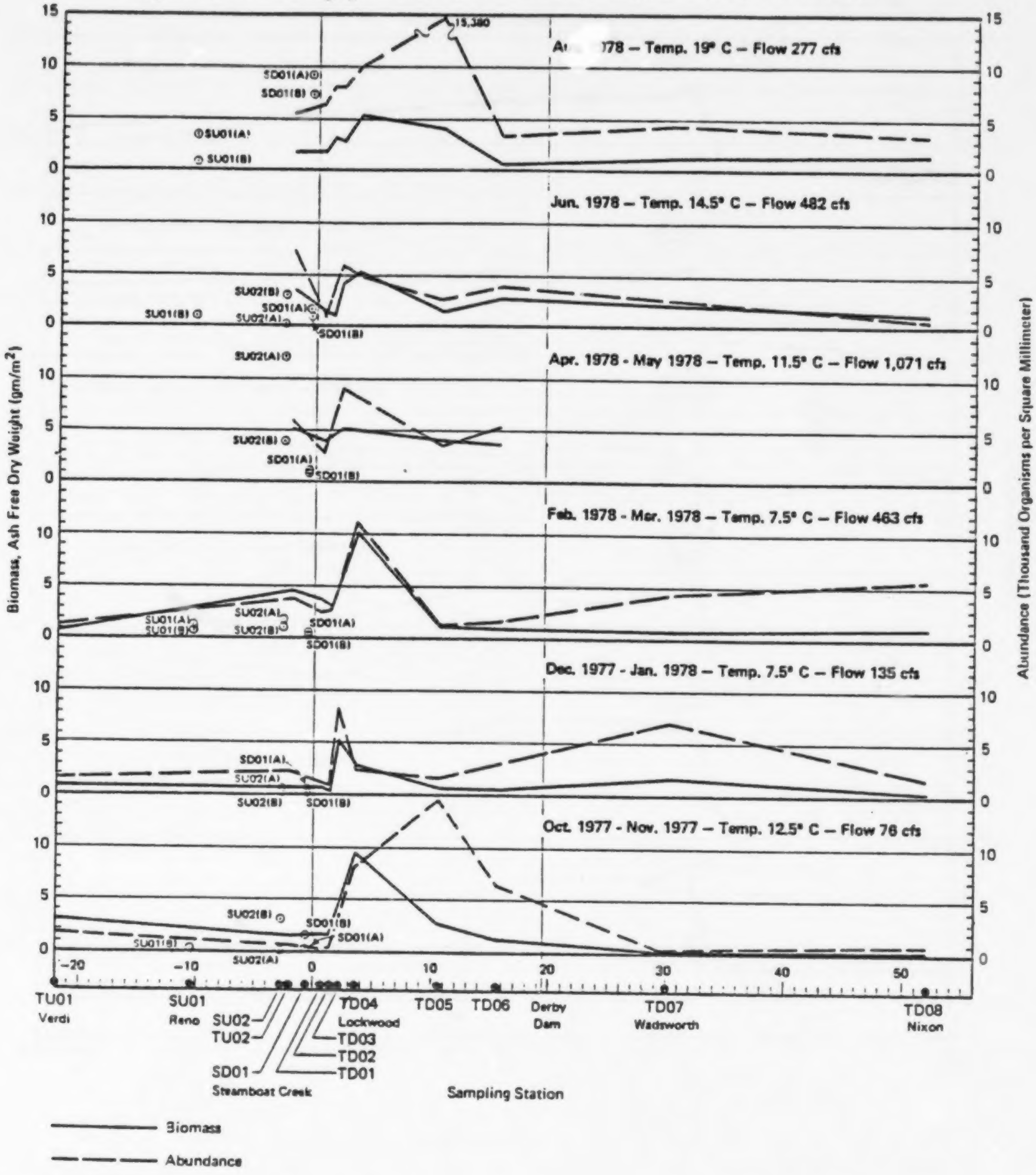
⊙ Sampling Stations not located on Truckee River.

Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratory, 1979.

Figure 4-8. Periphyton Measured in the Truckee River, 1977-1978



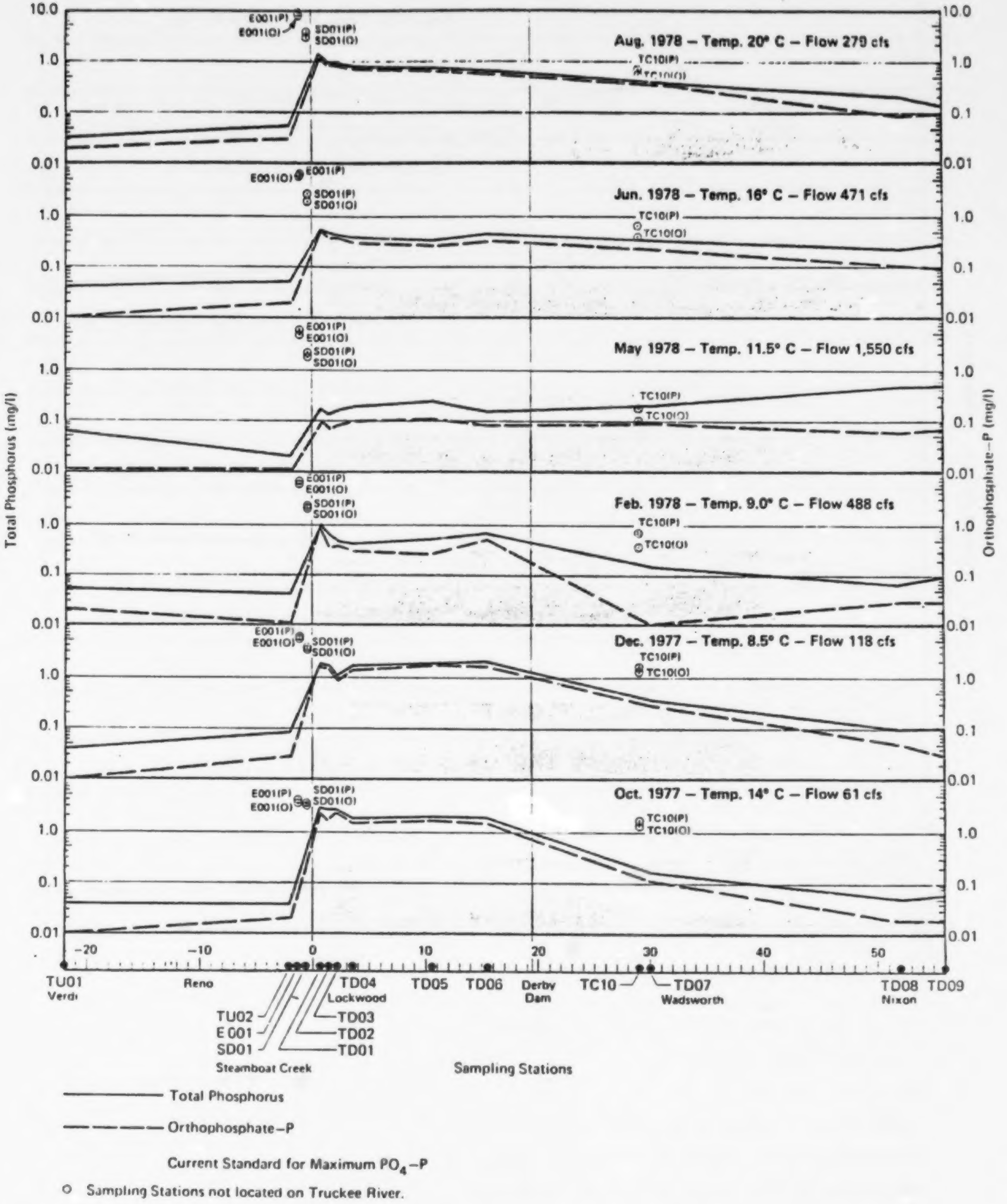
○ Sampling Stations not located on Truckee River.

Flows are averages for the Truckee River at Vista during test period.

Temperatures are averages for Truckee River Stations during test period.

SOURCE: Pacific Environmental Laboratories, 1979.

in 1977-1978

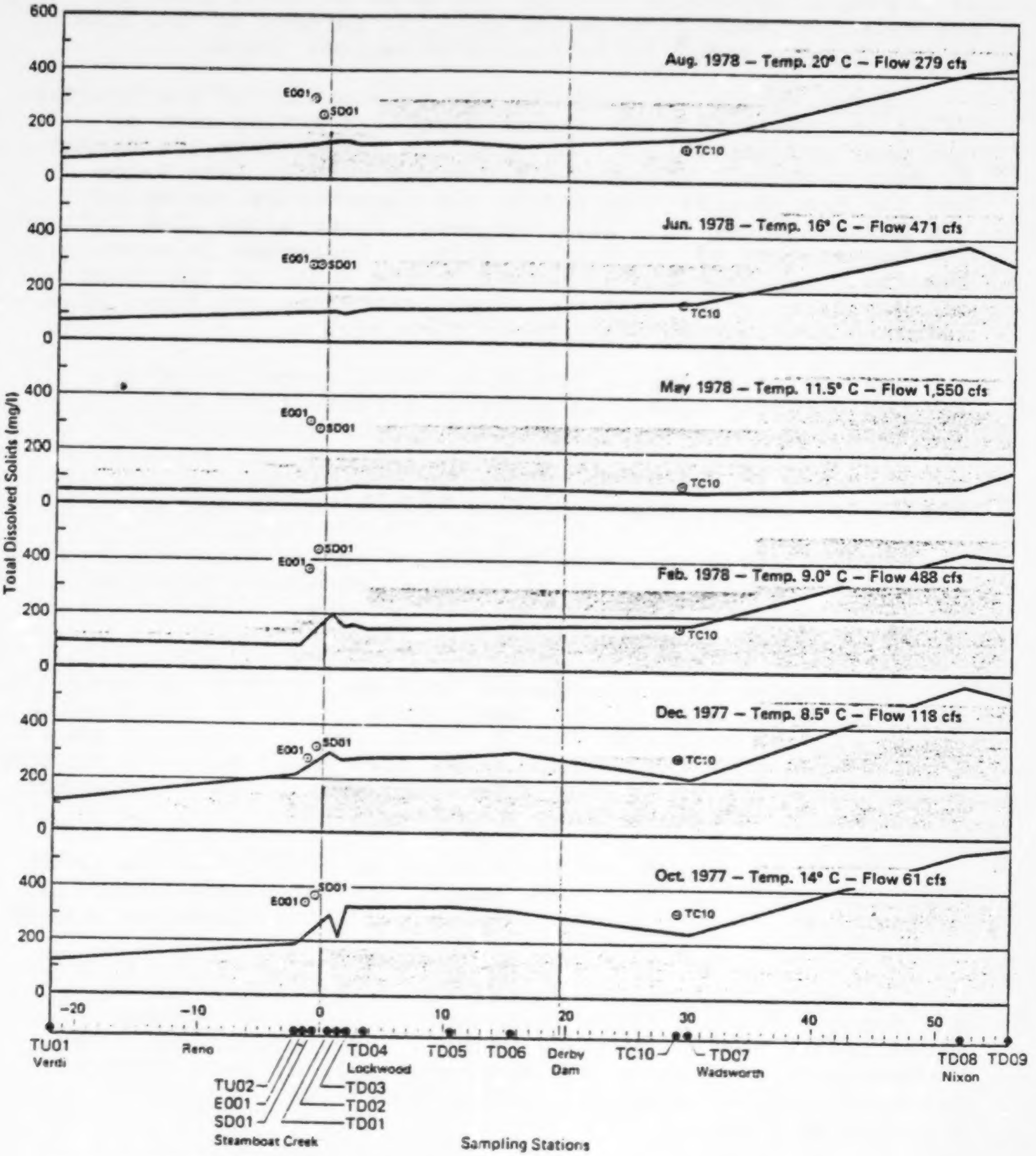


Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratories, 1979.

Figure 4-10. Total Dissolved Solids Measured in the Truckee River, 1977-1978



——— Total Dissolved Solids

- - - - Current Standard for Maximum Total Dissolved Solids

⊙ Sampling Stations not located on Truckee River.

Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratories, 1979.

The TDS concentration of the current JWPCP effluent is 315 mg/l, according to PEL. In terms of total loading, the existing JWPCP contributes about 12 percent of TDS load in the Truckee River downstream of Steamboat Creek.

Temperature. In general, the temperature of the Truckee River increases in a downstream direction during most of the year (Figure 4-11). Increases in temperature are caused by many factors. Climatic differences between Lake Tahoe and the Reno-Sparks area affect the temperature regime of the Truckee River to a large degree. Tributaries also influence the temperature of the Truckee River. Decreases in overhanging vegetation and increases in the width of the river allow greater solar heating. Agricultural return flows also increase the temperature.

An important factor governing the temperature of the Truckee River is flow. In general, greater flows will decrease temperatures of the river. Decreasing flows in the Truckee River will, in general, raise water temperature and decrease the spawning success of the Lahontan cutthroat and rainbow trout, assuming other things remain equal.

Hanson (1979) prepared a model of the physical factors affecting spawning success of Lahontan cutthroat trout in the Truckee River. Temperature was included as an important factor affecting spawning success.

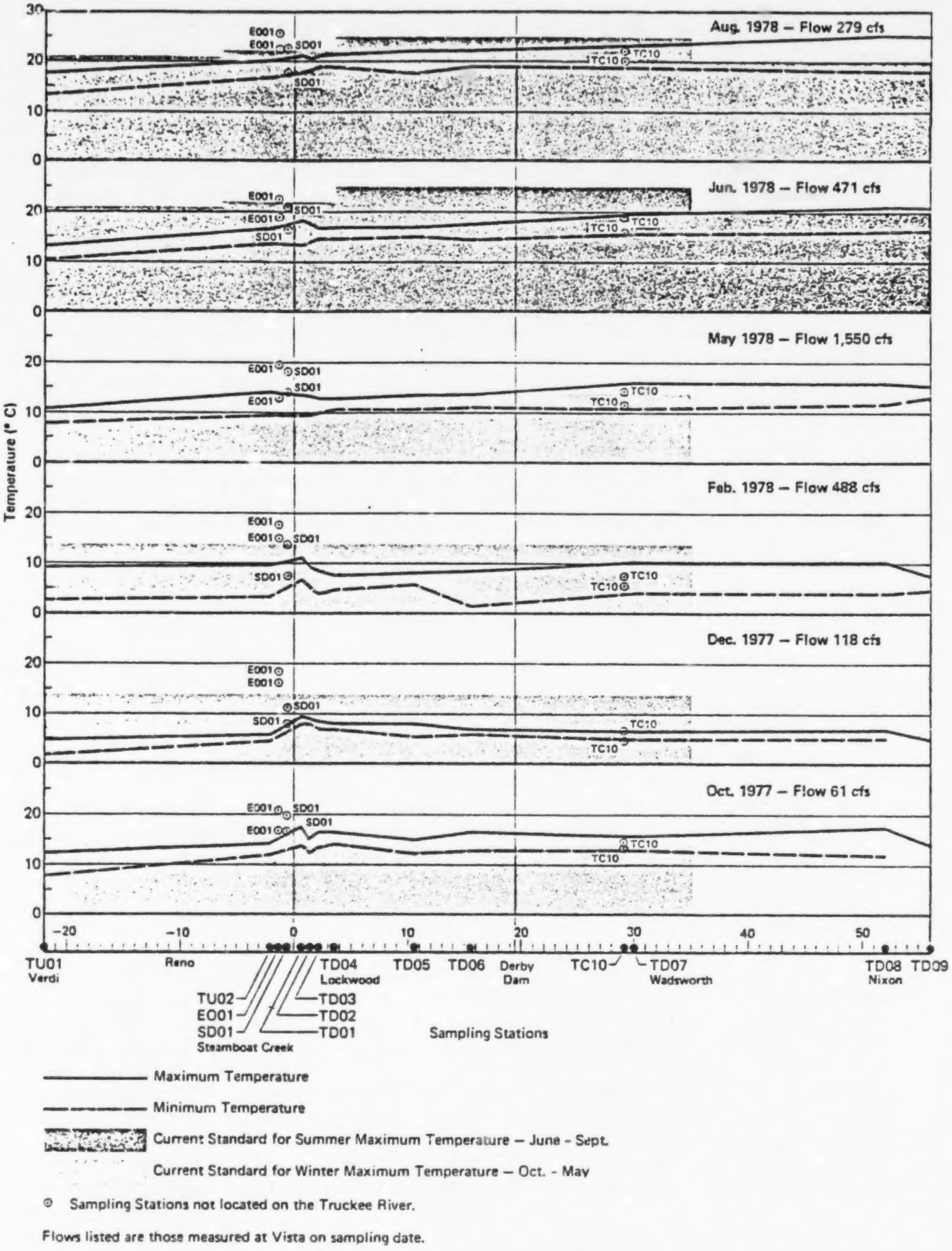
The reader is also referred to Rowell (1975) for information pertaining to the temperature regime of the Truckee River. The objective of Rowell (1975) was to develop a predictive model for the minimum flows that would maintain suitable temperatures in the Truckee River below Derby Dam for successful Lahontan cutthroat trout spawning.

PEL found an average temperature of 18.4°C for the JWPCP effluent. Objectives for the Master Project state a maximum winter temperature from the JWPCP of 22°C and a maximum summer temperature of 27°.

Nonpoint Pollution. Runoff from urbanized areas of the Truckee Meadows flows into the Truckee River through storm drains and agricultural drains tributary to the river. Concentrations of nitrogen, suspended solids, and coliform are high in Truckee Meadows urban runoff (URS Co., 1977). BOD is also high.

Pollutant loading to the Truckee River due to urban runoff occurs for a brief period of time, due to the surge of stormwater following rain. These short-term events affect water quality in the Truckee River for only a relatively brief period, but increase the total load influent to Lahontan Reservoir and Pyramid Lake.

Figure 4-11. Temperature Diurnal Range Measured on the Truckee River, 1977-1978



SOURCE: Pacific Environmental Laboratories, 1979.

The URS Co. estimated urban runoff quality through operation of the STORM simulation model (URS Co., 1977). The STORM model, which simulates urban runoff volume and quality, was calibrated against data collected during the summer of 1977 at various locations in the Truckee Meadows. The model estimated that the peak flow from urban runoff due to a 1-in-2-year storm would be 165 cfs. The pollutant loading rates determined from the modeling effort are shown in Table 4-18. Projected suspended solids and coliform loadings from urban runoff are high. Nitrogen forms, BOD and COD, which will exert an oxygen demand in the river, are also high. The URS Co. work identified the areas tributary to the North Truckee Drain and the Truckee River as having the highest pollutant concentrations of the four drainage areas. These areas include Sparks and northeast Reno, which drain to the North Truckee Drain, and the downtown Reno area, which drains to the Truckee River.

Urban runoff associated with an assumed year 2000 level of Truckee Meadows growth was also projected by the URS Co. (URS Co., 1978). This involved projecting land use patterns in the Truckee Meadows and modifying travel times for return flows and drainage patterns for the Orr Ditch drainage area. The peak flow from a 1-in-2-year storm was estimated to be 221 cfs. The estimated average pollutant loads determined from the analysis are shown in Table 4-19.

The loads shown in Tables 4-18 and 4-19 appear below Reno for only about a 4-hour period under model assumptions. This short-term pollutant influx will impact quality at Vista on a short-term basis, and will increase the total load influent to Lahontan Reservoir and Pyramid Lake.

In contrast to the brief loading to the Truckee River from urban runoff, agricultural return flows represent a more continuous source of pollution during the irrigation season. Impacts to the water quality of the Truckee River are correspondingly greater in terms of both duration and total pollutant loading.

As agricultural lands are urbanized in the future a reduction in total pollutant loading to the Truckee River will occur, because agricultural return flows represent a significantly greater annual pollutant load than urban runoff. The URS Co. (1977, 1978) estimated the impact of agricultural loading upon the Truckee River for the present and the year 2000. Their estimates were based upon areal pollutant loading rates for Spanish Springs Valley, which were then applied to the Truckee Meadows. URS Co. projected reductions in pollutant loads entering the Truckee River from agriculture.

Table 4-18. Estimated Average Urban Pollutant Loads
Truckee Meadows Area - Existing Land Use
(All Parameters in lbs/storm[1]
except for bacteria
billion MPN/storm)

	Orr Ditch (via Spanish Springs	N. Truckee Drain	Truckee River[4]	Steamboat Creek	Total[2]
BOD_5	28	68	460	180	710
COD	170	440	2,800	1,100	4,300
Suspended Solids	8,500	20,000	120,000	45,000	190,000
NO_3	2	5	36	13	54
NH_4	14	34	200	41	280
ORGN	12	31	200	80	310
OPO_4	3	8	43	18	69
TPO_4	8	19	110	41	170
Cd	0.02	0.08	0.54	0.20	0.82
Cr	0.1	0.4	2.8	1.2	4.4
Cu	0.6	0.8	12	4	17
Pb	7	16	100	39	160
FCOLI	600	1,400	8,500	3,100	13,000
FCOLI	8,000	19,000	110,000	39,000	170,000

1. The storm used in this analysis delivered 0.35 inches of rainfall in a 3 hour period (a typical summer storm with a recurrence interval of 2 years). The runoff generated by this storm extends over a 4 hour period.

2. Total load is based on a routing of the individual loads through the Vista gaging station and does not include the Orr Ditch loads, since their input is delayed for several days due to their passage through Spanish Springs. Average pollutant load is defined as the total pollutant load calculated by the STORM model for each drainage group.

3. Total load is based on a routing of the individual loads through the Vista gaging station. Average pollutant load is defined as the total pollutant load calculated by the STORM model for each drainage group.

4. Storm water hydrographs and pollutographs routed to Reno USGS Gage.

SOURCE: WCOG, 1978.

Table 4-19. Estimated Average Urban Pollutant Loads

TRUCKEE MEADOWS AREA - FUTURE LAND USE (YEAR 2000)
(All parameters in lbs/storm[1] except
for bacteria (billion MPN/storm))

	N. Truckee Drain	Truckee River[4]	Steamboat Creek	Total[3]
BOD_5	230	630	330	1,200
COD	1,400	3,700	2,000	7,100
Suspended Solids	67,000	140,000	86,000	290,000
NO_3	17	46	24	87
NH_4	110	270	140	520
ORGN	100	260	150	510
OPO_4	25	57	34	120
TPO_4	61	150	75	290
Cd	0.29	0.72	0.35	1.4
Cr	1.6	4.0	2.1	7.7
Cu	6	15	7	28
Pb	53	140	71	260
FCOLI	4,700	11,000	6,000	22,000
TCOLI	62,000	150,000	78,000	290,000

1. The storm used in this analysis delivered 0.35 inches of rainfall in a 3 hour period (a typical summer storm with a recurrence interval of 2 years). The runoff generated by this storm extends over a 4 hour period.

2. Total load is based on a routing of the individual loads through the Vista gaging station and does not include the Orr Ditch loads, since their input is delayed for several days due to their passage through Spanish Springs. Average pollutant load is defined as the total pollutant load calculated by the STORM model for each drainage group.

3. Total load is based on a routing of the individual loads through the Vista gaging station. Average pollutant load is defined as the total pollutant load calculated by the STORM model for each drainage group.

4. Storm water hydrographs and pollutographs routed to Reno USGS Gage.

SOURCE: WCOG, 1978.

Septic tank leachfield systems in the southwest portion of the Truckee Meadows were also identified as pollution sources in this reach of the Truckee River (WCOG, 1980a). There is a package treatment plant in this area, although its effluent is discharged to the land. Other similar plants have been proposed in this area.

Increasing control over nonpoint pollution sources is expected by WCOG as part of 208 program activities.

Mitigations. Individual septic tanks will gradually be phased out as these areas are sewered. One aspect of this is the construction of the Lawton-Verdi interceptor. Package sewage treatment plants are being required to utilize tertiary treatment before land disposal. These plants will also be required to hook up to the JWPCP once the Master Project is completed.

Nonpoint source pollution due to urban runoff can be mitigated through several measures. Street sweeping and parking ordinances have been suggested as ways to reduce the urban pollutant load (URS Co., 1978d). It was estimated that street sweeping once a week, combined with a strict parking ordinance, would lead to a reduction in pollutant loads approaching 50 percent. Street sweeping twice a week, combined with a parking ordinance, was estimated to result in a 75 percent reduction in the pollutant load (URS Co., 1978d). Street sweeping and parking ordinances are currently being implemented as a way of mitigating the urban pollutant problem, and to improve air quality.

URS Co. (1978d) also recommended sedimentation basins as a method of treating urban runoff. A North Truckee Drain basin and Steamboat Creek basin were recommended. These two basins were estimated to have a removal efficiency of 60 percent. Since these two basins would only trap about one-half of the urban flows their total overall efficiency is estimated to be 32 percent (URS Co., 1978d). Sedimentation basins, combined with street sweeping and parking ordinances, should therefore achieve around an 85 percent reduction in suspended solids (URS Co., 1978d).

The urban runoff problem is currently being studied by the USGS. This current study will look at runoff from approximately 25 storms per year, including rainfall, snowmelt, and thunderstorms. One objective of their study is to develop a predictive tool that can be used to project loadings from drainage areas and compare with an allowable loading.

This study, when complete, can be used to further define the role of urban runoff in the Truckee River quality. Control measures can be implemented as problem areas are defined.

As agricultural land goes out of production due to urbanization, the pollutant load from agricultural sources should decrease (Table 4-20). In this way, urbanization becomes a mitigation for agricultural pollutant loads. In the future there will be reductions in surface water and groundwater pollutant loading from agriculture.

WCOG (1980a) states that pollutant loads currently derived from the Helms Gravel Pit will not occur in the future as this area will be converted to a sedimentation/flood control facility.

It is hoped that these control measures will reduce the background loading of the Truckee River. There are no overall estimates of how new nonpoint sources and reduction of existing nonpoint sources might affect background quality. There is also no assurance that the control measures will be implemented or retained as permanent mitigations. No quantification is attempted in this EIS, except to assume that background loads will remain unchanged.

Steamboat Creek to Vista

The reach of the Truckee River from the North Truckee Drain and Steamboat Creek to Vista receives the major portion of the agricultural return water from Truckee Meadows and the sewage effluent from the Reno-Sparks JWPCP. Mixing, dispersion and dilution of these waste loads occur in this reach, which is obviously the most degraded segment of the river.

According to the water quality standards, this reach is afforded the same protection and should support the same beneficial uses as up and downstream segments, although water quality standards are increased for some substances from the upstream to the downstream control point. Water quality and biological records indicate, however, that some beneficial uses are seasonally excluded or impaired by water quality in this reach. Bathing and water contact sports would be done at greater relative risk of infection by pathogenic organisms. Fishing in this and lower segments has been declining since before 1960 (Sumner, pers. comm.). The aquatic habitat shows numerous symptoms associated with water pollution.

Table 4-20. Estimated Pollutant Loads from Agricultural Sources Draining to Steamboat Creek and the North Truckee Drain (lbs/day)[1]

Pollutant	Present	2000
TDS	68,000	41,800
Suspended Solids	9,200	5,650
Settleable Solids	5,265	3,200
BOD	490	30
Total Phosphorus	50	32
Dissolved Phosphorus	34	20
Nitrate	70	43
TKN	244	151
Fecal Coliform (10^9 organisms/day)	580	365
Flow (cfs)	49	30

[1] Except where noted.

SOURCE: URS Co., 1977; 1978c.

Hydrology in this segment is complicated by the convergence of four major inflows: 1) the Truckee River from Reno, 2) North Truckee Drain, 3) Steamboat Creek, and 4) the JWPCP effluent, which has the only relatively constant input: it averages about 30 cfs. The regulated river flow changes most dramatically and tends to govern the dilution and dispersion of wastes in this mixing zone. The relative flows and pollutant loads of the Truckee River, Steamboat Creek and the North Truckee Drain, in addition to the JWPCP effluent, determine the quality below Steamboat Creek. Water quality as measured in the river responds to both the input load and the coincident conditions of flow. The pollutant loads entering the Truckee River from these sources are also shown graphically for each constituent. Figures 4-12 through 4-19 diagram particular constituent loads from stateline to Vista.

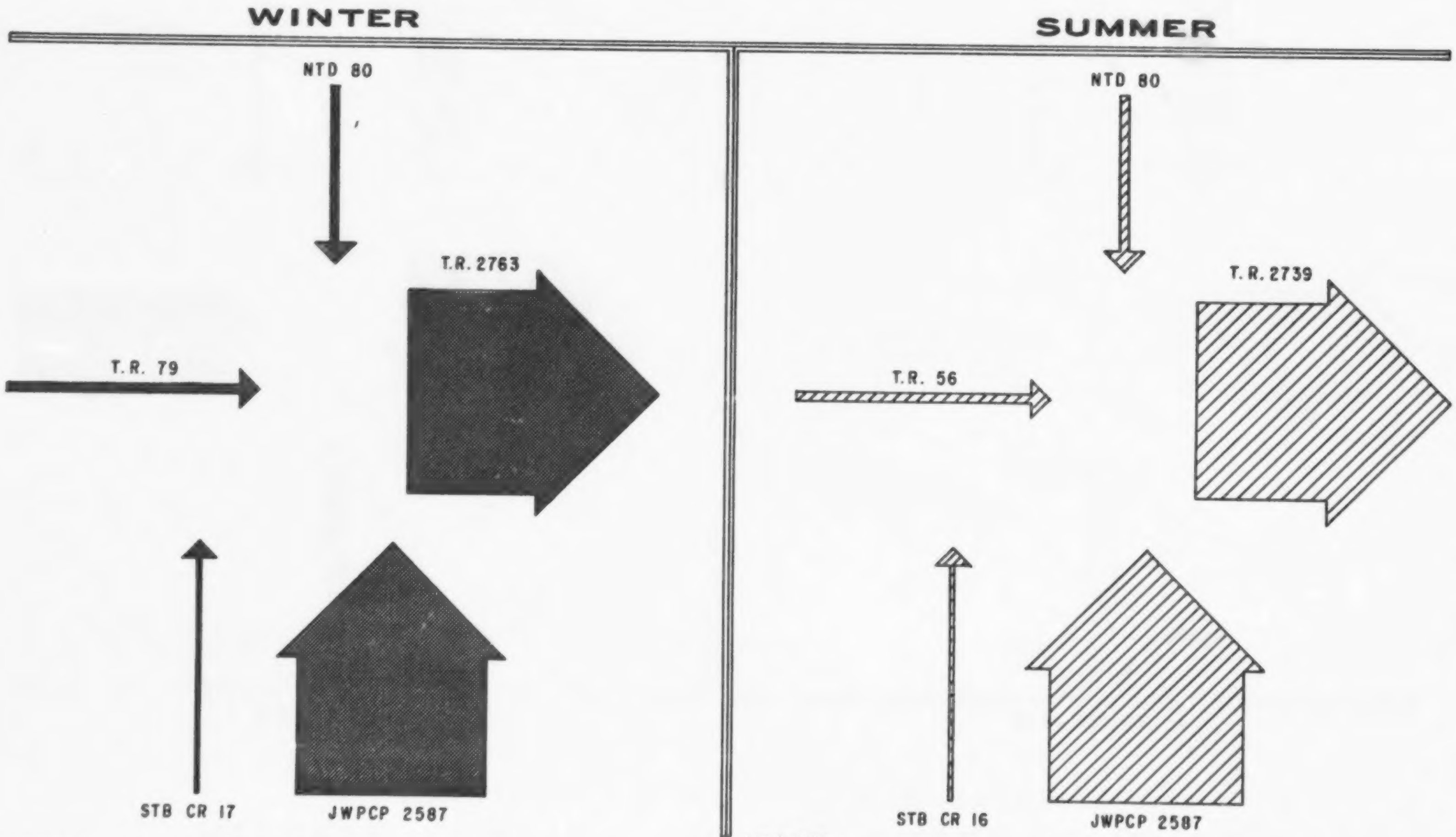
The PEL report characterizes the water quality and biotic conditions in the river. Through these studies, PEL concluded that toxic conditions occur because of excessive concentrations of residual chlorine, ammonia, nitrite, nitrate, and zinc. Except for nitrate, all of these substances are commonly known to be highly toxic to fish and other aquatic organisms at relatively low concentrations. Whereas the other toxicants acutely affect almost all life stages of aquatic animals, nitrate toxicity may be most signifiant to only the completion of egg development and hatching. Consequently, the effects may be limited by species, season and location rather than being all encompassing. In order to provide protection to the fishery resources of the Truckee River, the EPA (1976) has recommended toxicity standards (water quality guidelines) for ammonia, nitrite, nitrate and chlorine. These recommended concentrations are contrasted to the state standards at Lockwood in Table 4-21.

The community of plants and animals in this reach and the next lower reach are indicative of excessive waste loading, and were classified as "polluted" by PEL. The immediate adverse effects of large-scale waste loading to this reach are obvious from their data.

The Truckee River between Steamboat Creek and Vista is directly and intensively impacted by the JWPCP. Accordingly, individual water quality constituents will be discussed separately in the following sections. Water quality data collected by PEL (1979) were used extensively to evaluate background conditions in order to screen the potential impacts of Master Project alternatives.

Figure 4-12

AMMONIA LOADING TO THE TRUCKEE RIVER
IN THE STATELINE TO VISTA REACH

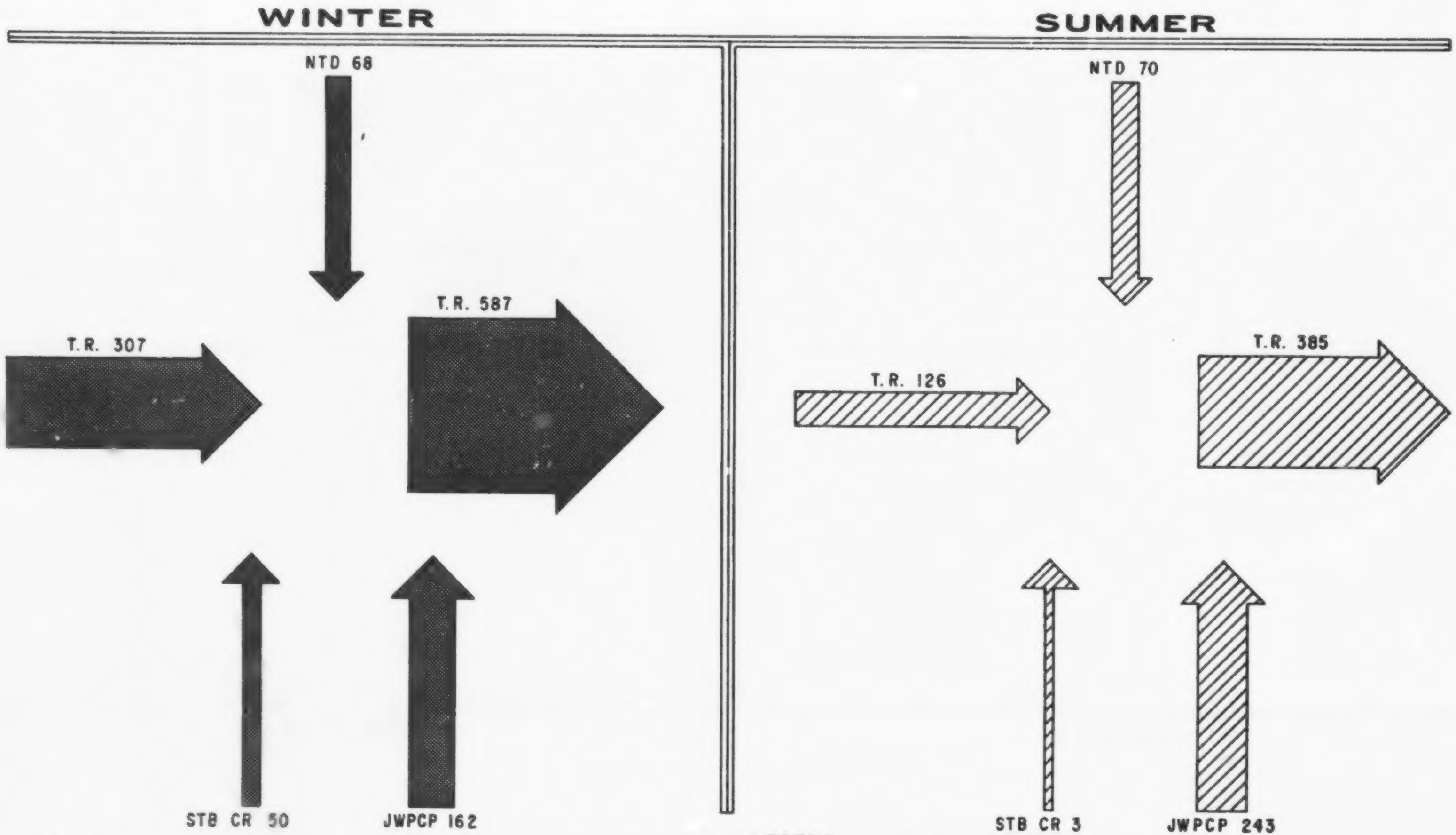


SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD-NORTH TRUCKEE DRAIN
STB CR-STEAMBOAT CREEK
T.R.-TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

Figure 4-13

NITRATE LOADING TO THE TRUCKEE RIVER
IN THE STATELINE TO VISTA REACH



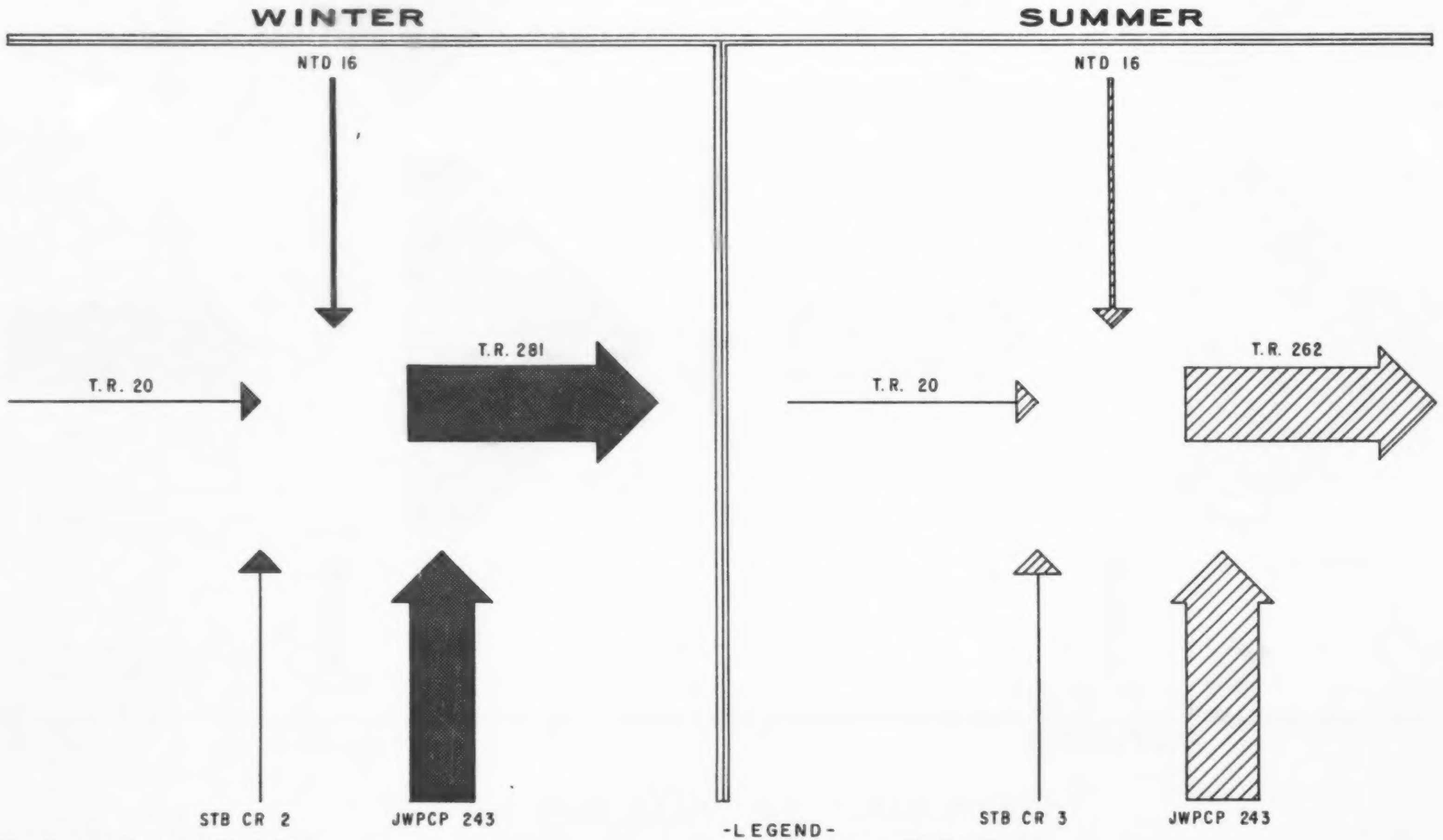
SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD-NORTH TRUCKEE DRAIN
STB CR-STEAMBOAT CREEK
T.R.-TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

Figure 4-14

NITRITE LOADING TO THE TRUCKEE RIVER

IN THE STATELINE TO VISTA REACH

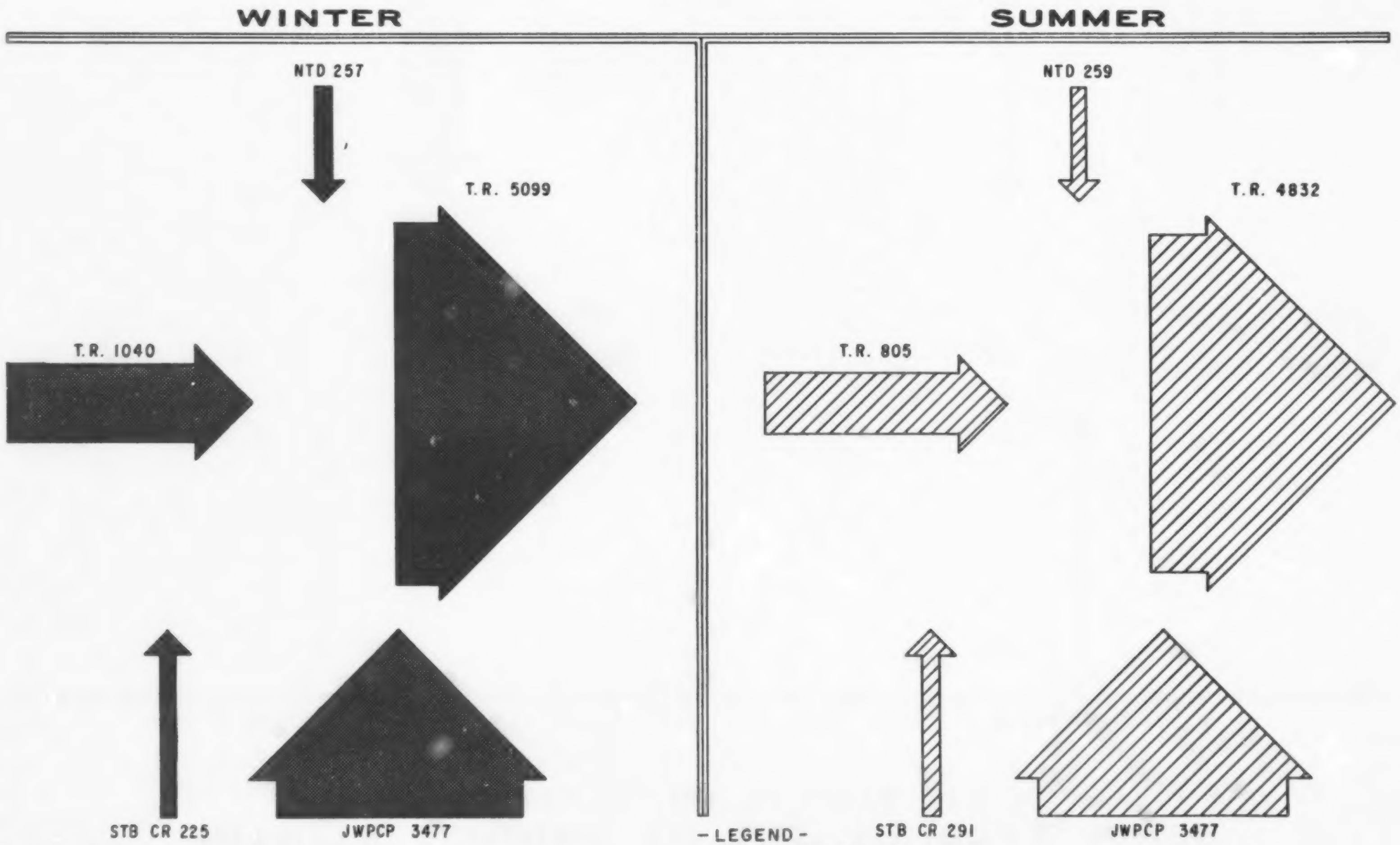


SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD - NORTH TRUCKEE DRAIN
STB CR - STEAMBOAT CREEK
T.R. - TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

Figure 4-15

TOTAL N LOADING TO THE TRUCKEE RIVER
IN THE STATELINE TO VISTA REACH

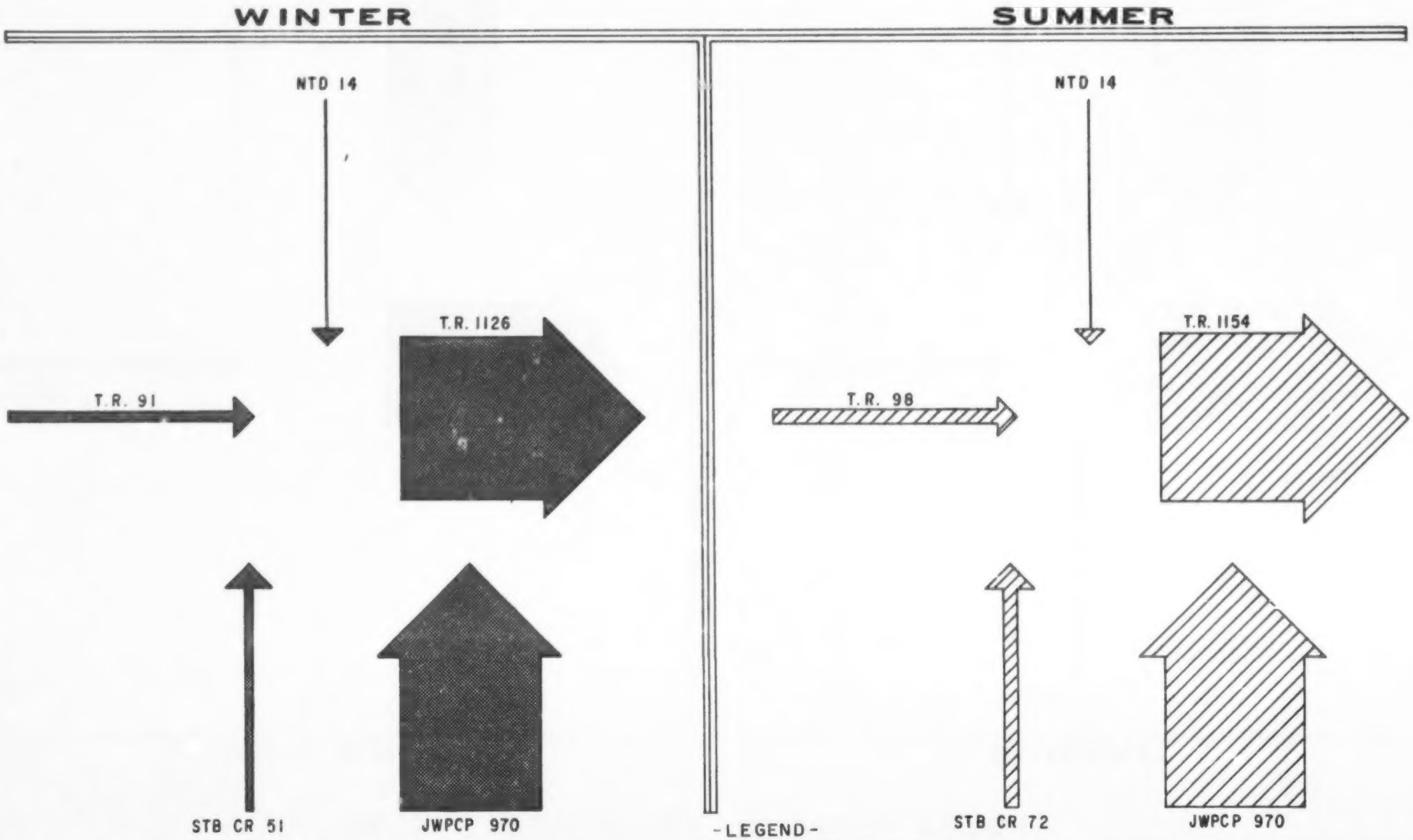


SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD - NORTH TRUCKEE DRAIN
STB CR - STEAMBOAT CREEK
T.R. - TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

Figure 4-16

TOTAL P LOADING TO THE TRUCKEE RIVER
IN THE STATELINE TO VISTA REACH

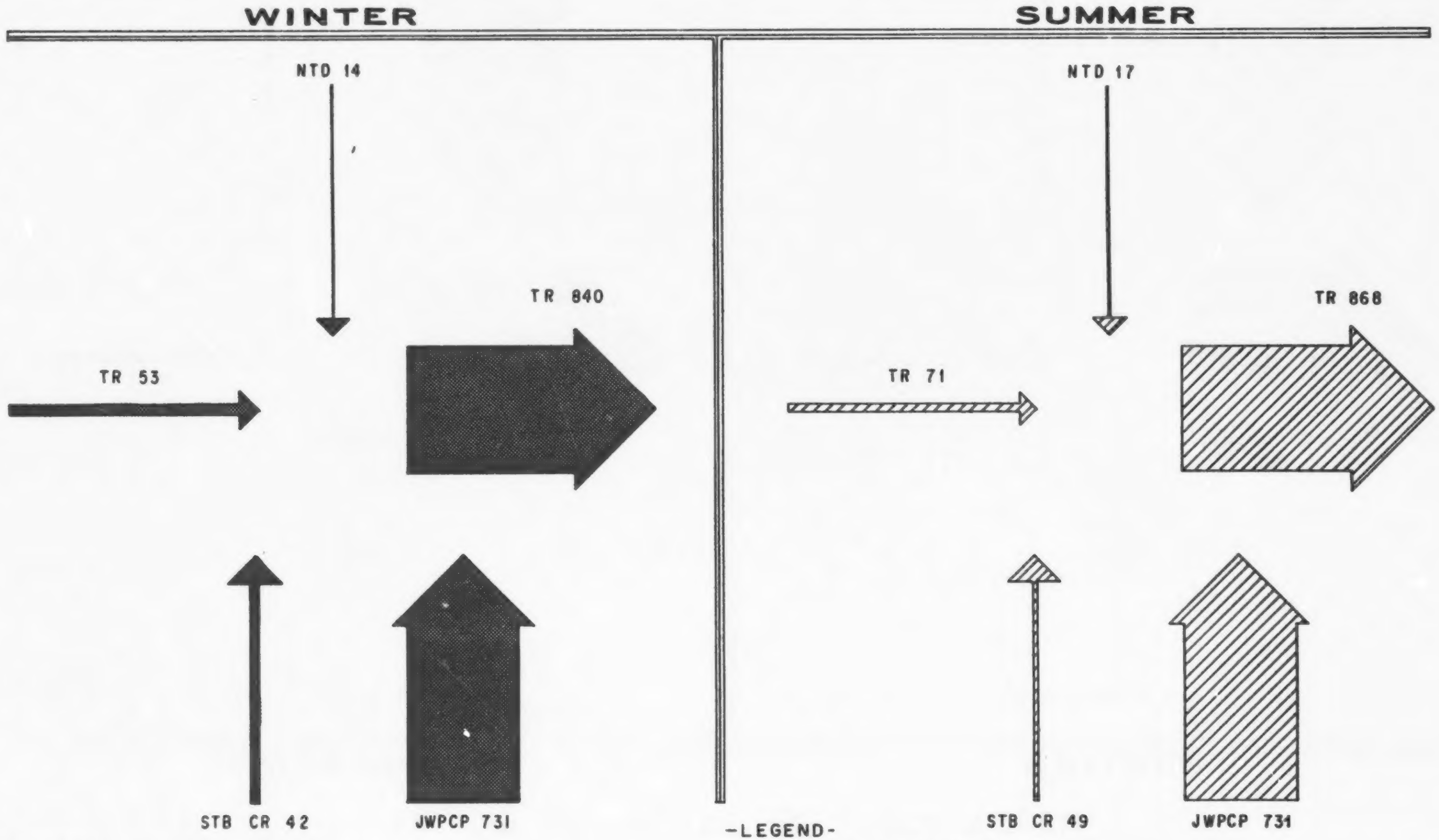


-LEGEND-
NTD - NORTH TRUCKEE DRAIN
STB CR - STEAMBOAT CREEK
T.R. - TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

SOURCES: DRI UNPUBLISHED DATA
KENNEDY / JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

Figure 4-17

PHOSPHATE LOADING TO THE TRUCKEE RIVER
IN THE STATELINE TO VISTA REACH



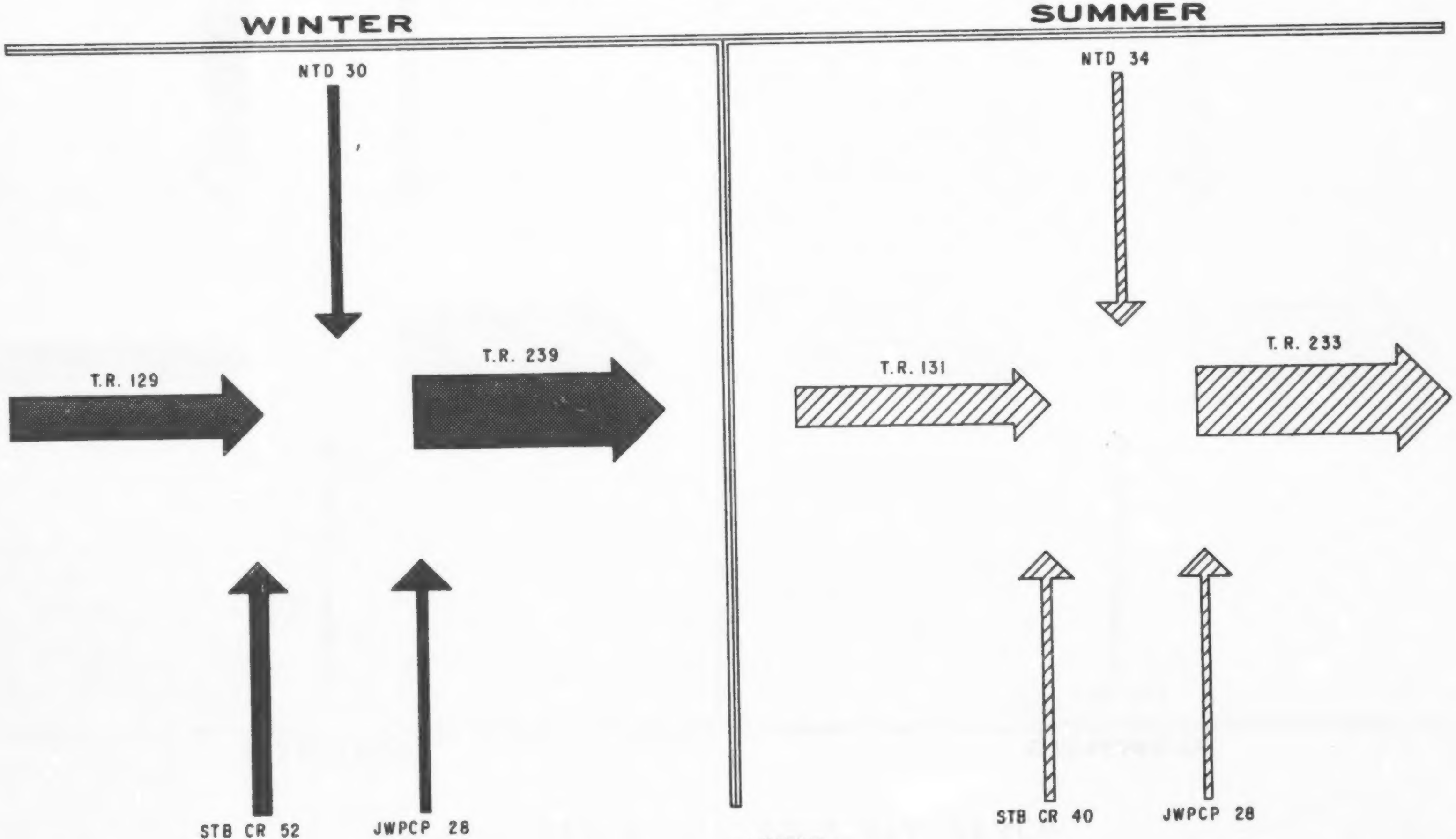
SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD - NORTH TRUCKEE DRAIN
STB CR - STEAMBOAT CREEK
T.R. - TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

Figure 4-18

TOTAL DISSOLVED SOLIDS LOADING TO THE TRUCKEE RIVER

IN THE STATELINE TO VISTA REACH

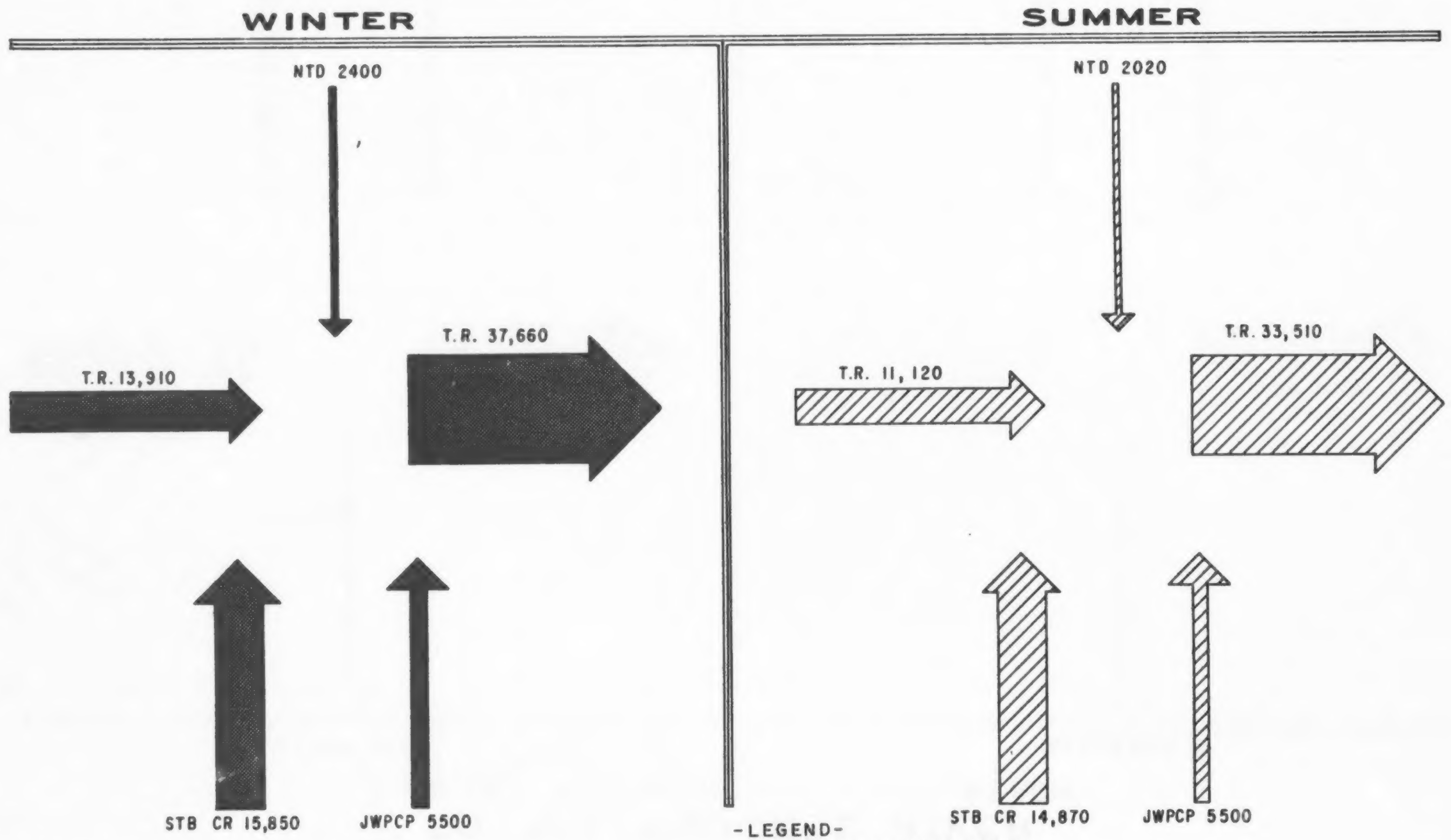


SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD - NORTH TRUCKEE DRAIN
STB CR - STEAMBOAT CREEK
T.R. - TRUCKEE RIVER
NUMBERS INDICATE TONS PER DAY

Figure 4-19

CHLORIDE LOADING TO THE TRUCKEE RIVER
IN THE STATELINE TO VISTA REACH



SOURCES: DRI UNPUBLISHED DATA
KENNEDY/JENKS ENGINEERS, 1979
JONES & STOKES ASSOCIATES, INC.

-LEGEND-
NTD-NORTH TRUCKEE DRAIN
STB CR-STEAMBOAT CREEK
T.R.-TRUCKEE RIVER
NUMBERS INDICATE LBS. PER DAY

Table 4-21. Comparison of Truckee River Water Quality Standards for Lockwood Bridge and Environmental Protection Agency's Recommended Standards

	State of Nevada, Truckee River at Lockwood Bridge[1] (mg/l)	Environmental Protection Agency Recommendations (mg/l)
Unionized Ammonia	0.016	0.02
Nitrite	0.039	0.06
Nitrate	2.0	*
Residual Chlorine	0.002	0.002
Zinc	0.0009	0.01 of the 96-hour LC_{50}

FOOTNOTES:

*The drinking water standard of 10.0 mg/l is recommended as a nitrate criterion.

[1] No single sample may exceed these levels.

DATA SOURCE: EPA, 1976; State of Nevada, 1979.

Dissolved Oxygen. Large amounts of oxygen-consuming carbonaceous and nitrogenous material enter the river between Steamboat Creek and Vista. The oxygen demand associated with the JWPCP effluent, combined with photosynthesis and total stream respiration, have led to intense diurnal fluctuations in DO (Figure 4-20). DO concentrations fluctuate significantly downstream of the JWPCP outfall. Data indicate that the DO standard is probably violated during summer months when river flows are low. The diurnal variations of DO measured by PEL are indicative of a nutrient enriched river.

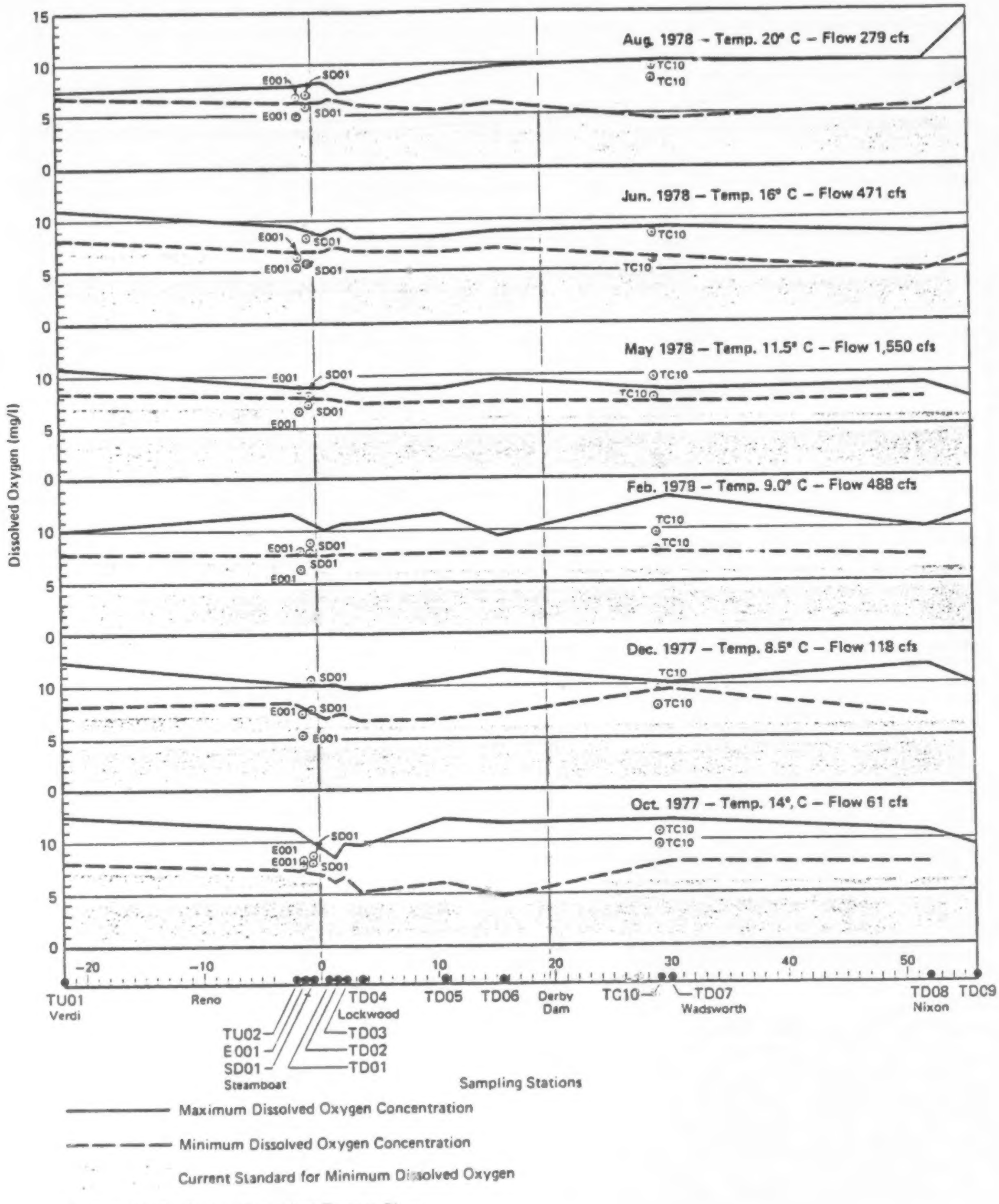
Biochemical Oxygen Demand. Biochemical oxygen demand (BOD) increases below Steamboat Creek (Figure 4-21). This increase is primarily due to the effluent discharge from the JWPCP, and is reflected in decreased concentrations of DO as discussed previously. During the time of the PEL study, the effluent average carbonaceous BOD concentration was about 8 mg/l and the average daily demand of approximately 1,130 lbs/day. At full utilization of the 30 mgd ESP the average daily demand will change to 2,000 lbs/day.

BOD in river bottom sediments was also examined by PEL. The results indicate increasing concentrations below the JWPCP and during low flows. It is thought that a large portion of the sediment BOD washes downstream during high flow periods.

High concentrations of BOD in sediments tends to indicate that DO concentrations in the interstitial water in the bottom substrate are at times low or depleted. DO conditions in bottom sediments are a limiting factor for invertebrate species and low DO is reflected by large populations of a few species tolerant of low DO. Depleted DO can result in the absence of aquatic invertebrates. Moreover, high BOD and low DO in the sediments impairs the reproductive success of fish spawning on or in the sediments. Trout, for example, bury their eggs in the gravel with the biological expectation of the DO being greater than about 7 mg/l. DO less than about 5 mg/l impairs growth and increases mortality of the embryos and pre-emergent fry. Elevated BOD in sediments below Steamboat Creek indicates a high likelihood that spawning substrates are impaired by low concentrations of DO.

Unionized Ammonia (NH_3). Unionized ammonia concentrations measured during 1977-1978 by PEL exhibit an order of magnitude increase at Steamboat Creek (Figure 4-22). It is apparent that the JWPCP effluent causes increases in unionized ammonia concentrations in the Truckee River. During the time of the PEL study, the average concentration of ammonia

Figure 4-20. Dissolved Oxygen Diurnal Range Measured in the Truckee River in 1977-1978

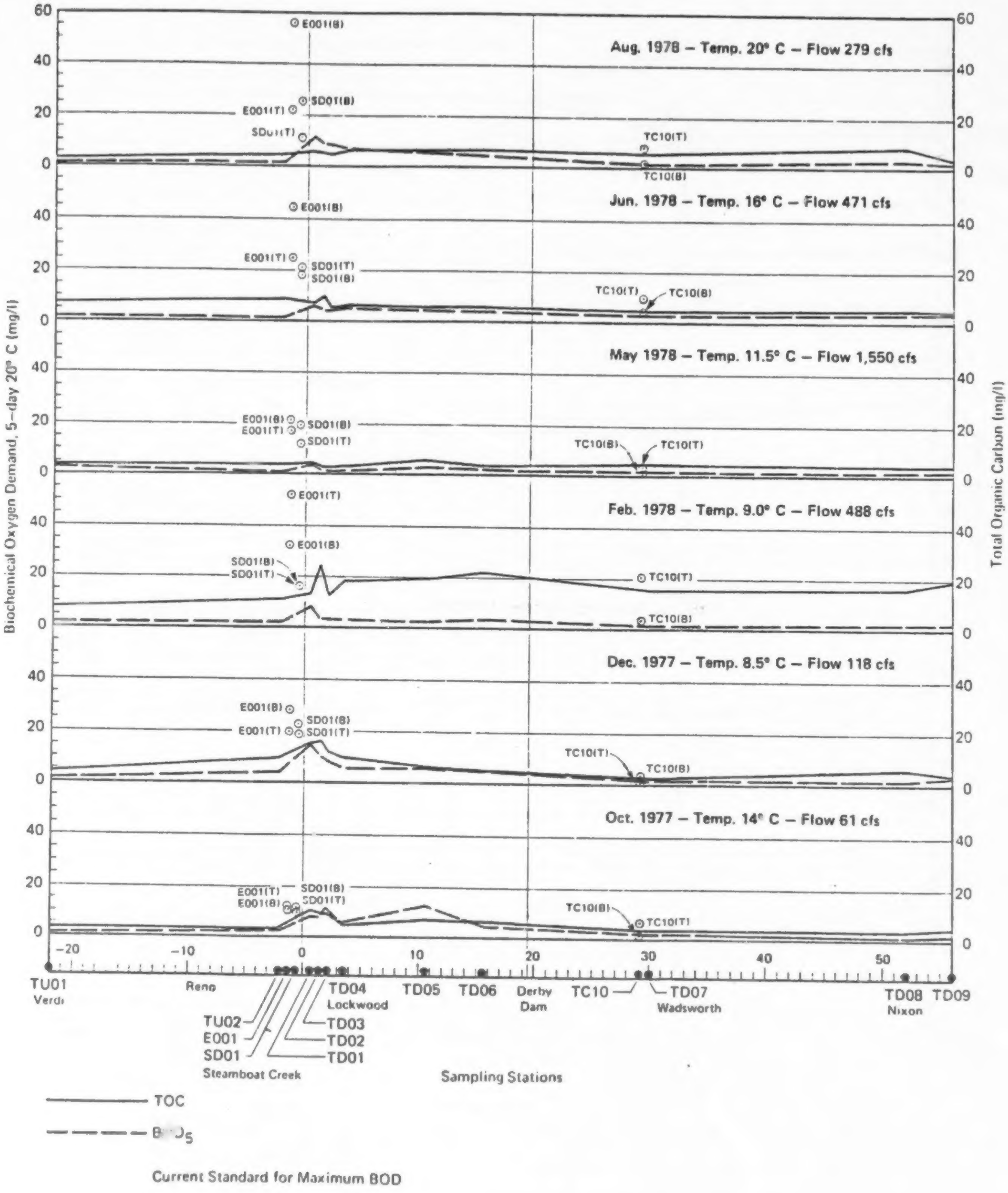


Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratories, 1979.

Figure 4-21. BODs and TOC in the Truckee River in 1977-1978.



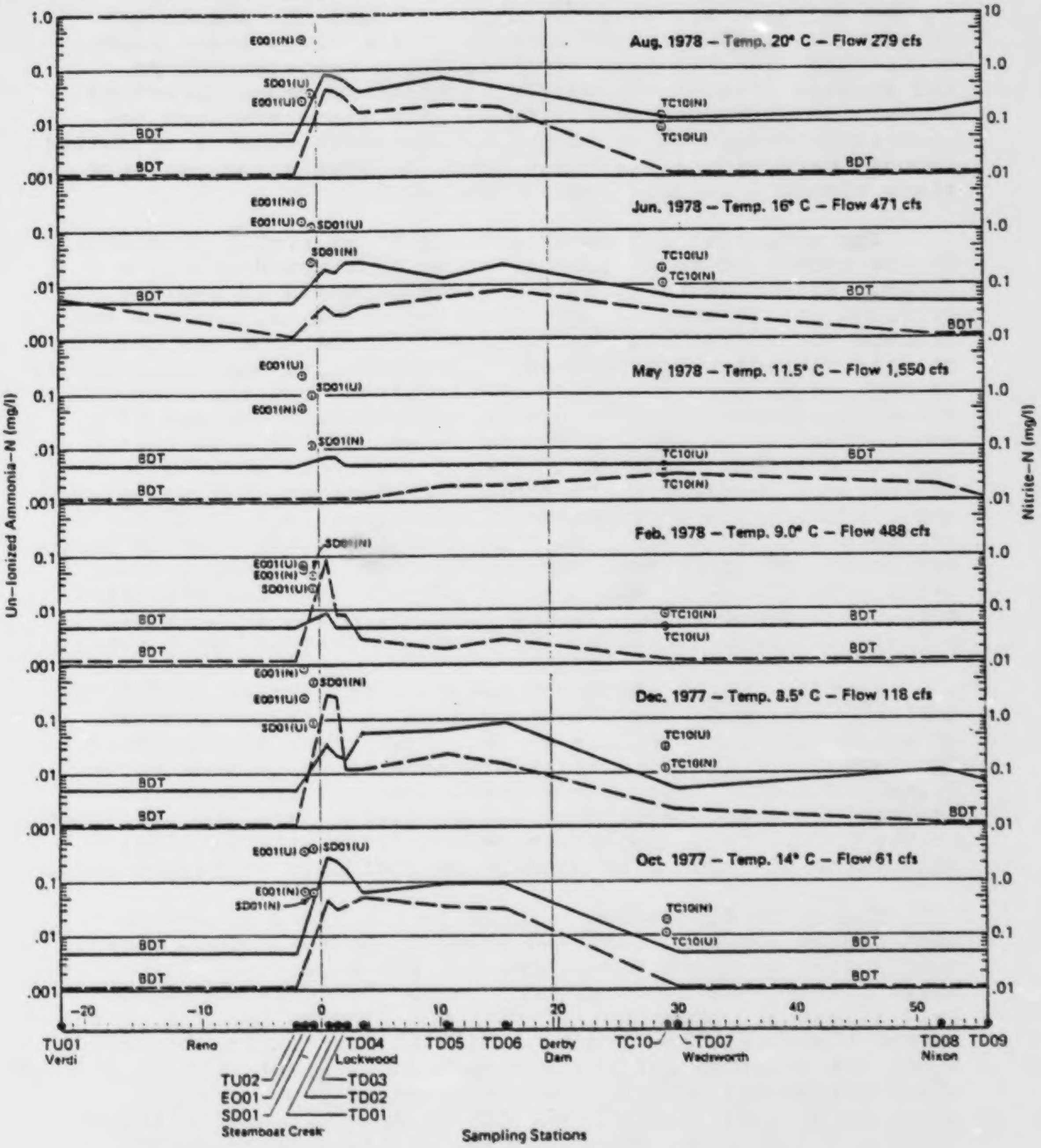
⊙ Sampling Stations not located on Truckee River.

Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratories, 1979.

Figure 4-22. Unionized Ammonia-N and Nitrite-N Measured in the Truckee River in 1977-1978



——— Un-Ionized Ammonia-N

— — — — Nitrite-N

BDT = Below Detectable Limit

⊙ Sampling Stations not located on Truckee River.

Flows listed are those measured at Vista on sampling date.

Temperatures are averages of diurnal temperatures at all Truckee River Stations.

SOURCE: Pacific Environmental Laboratories, 1979.

in the effluent was 14.8 mg/l. At present the discharge of high concentrations of ammonia to the river cause acutely toxic conditions to fish when dilution, temperature, pH, and ammonia concentrations act together to cause unionized ammonia to exceed about 0.2 mg/l. The state standard for unionized ammonia is 0.016 mg/l. Concentrations of unionized ammonia have exceeded acutely toxic concentrations and the state standard in this reach (PEL, 1979).

The potential for ammonia toxicity is highly dependent on the amount of total ammonia being discharged from the JWPCP. After discharge to the river, ammonia is rapidly oxidized to nitrate. A comparison of the total ammonia and nitrate concentrations in Figure 4-6 illustrates the results of this nitrification process. Consequently, ammonia toxicity is most acute near the point of discharge, but the risk of toxicity remains for some distance downstream because of the increasing pH that is typically associated with this type of nutrient enrichment situation. Total ammonia concentrations decrease quite rapidly downstream, but unionized ammonia concentrations decrease downstream less rapidly (Figures 4-6 and 4-22). As nutrients are being used in photosynthesis, pH increases; small increases in pH may convert large proportions of the ammonia present into the unionized and, thus, toxic form. In the past unionized ammonia has potentially been a problem as far downstream as Derby Dam.

Nitrite (NO_2). Data collected by PEL during 1977-1978 indicate extremely low concentrations of nitrite upstream of Steamboat Creek (Figure 4-22). Downstream of the JWPCP discharge, nitrite concentrations were found to peak above Vista. A second peak in nitrite concentrations occurred between Vista and Derby Dam, except during sampling performed in May 1978. This downstream peak reflects the nitrifying conversion of ammonia to nitrate as indicated in Figure 4-22.

The JWPCP discharges nitrite to the river in amounts that can be toxic to fish and other organisms, i.e., concentrations of about 0.2-0.4 mg/l. PEL reported nitrite toxicity for this reach of the river. PEL data in Figure 4-22 illustrate the level of risk for nitrite toxicity. The warmer the water, the greater the risk for nitrite toxicity. Since the existing JWPCP discharges an effluent with an average nitrite-nitrogen (NO_2-N) concentration of about 3 mg/l, toxic conditions in the river can be expected when dilution flows are less than about 300 cfs. Nitrite is an intermediate product in the oxidation of ammonia to nitrate and this process has acted to keep significant levels of nitrite in the river between Steamboat Creek and Derby Dam (Figure 4-22).

Algal Growth Potential. Algal growth potential (AGP) studies were conducted on the Truckee River by several investigators (PEL, 1979; EPA, 1977; DRI, 1980; McLaren, 1977; Seil, 1973). These studies indicate that additions of nutrients, particularly nitrogen an[illegible]hosphorus, contained in sewage effluents stimulate algal growth. PEL (1979) and Lider, et al. (1980) found that orthophosphate added to Truckee River water collected above the JWPCP outfall did not significantly stimulate growth. Nitrate, on the other hand, had a stimulatory effect upon growth. From these results it was concluded that the river above the JWPCP outfall is generally nitrogen-limited but overall is both nitrogen- and phosphorus-limited. Downstream of the outfall, the river is nitrogen limiting. The ratio of nitrogen to orthophosphate concentration of 11:1 was used as a criterion for nutrient limitation in the river. The nutrient loading to the Truckee River under the ESP will be increased in terms of nitrogen, but greatly reduced for phosphorus.

The river below the outfall will be phosphorus-limiting. Excessive algal growth will continue to occur under the ESP, but algal biomass should be reduced from levels reported by PEL (1979). Algal growth will rapidly use the phosphorus, thus reducing it to limiting concentrations of 0.05-0.08 mg/l and nitrogen, in turn, should remain in excess.

Algal uptake of nutrients will reduce both nitrogen and phosphorus concentrations in the river water. The phosphorus concentration is expected to be reduced to near background levels by Derby Dam. The cycling of nutrients may introduce phosphorus back into the water column and these sources will be readily used.

Although there will be a large amount of nitrogen present in the river under the ESP, its effect on algal growth in the river is expected to be controlled by the phosphorus concentration. The $O\text{-}PO_4\text{-}P$ levels in this reach are expected to be around 0.05 mg/l.

Early Start Project. The PEL data are a good indication of current quality conditions in the Truckee River. By the end of the ESP these conditions will be amended somewhat by the expansion and modification of the treatment process. The implementation of chlorine removal to meet an effluent standard of 0.01 mg/l will mitigate a major source of acute toxicity in the mixing zone.

Pollutant loading to the Truckee River following the EPS was estimated using the background conditions measured by PEL and the projected effluent quality. The resultant average annual pollutant loads below the outfall are shown in Table 4-22.

Table 4-22. Projected Average Annual Pollutant Loads in the Truckee River Below Steamboat Creek Following Completion of the Early Start Project (lbs/day[1])

	Background[2]	JWPCP-ESP at 30 mgd[3]	Total
Nitrate	556	250	806
Nitrite	25	375	400
Ammonia	146	4,000	4,146
Organic Nitrogen	2,585	750	3,335
Total Nitrogen	3,283	5,379	8,662
Total Phosphate	137	100	237
Orthophosphate	71	100	171
Chloride	19,688	8,500	28,188
TDS	120	44	164
BOD	3,328	1,000[4]	4,328

FOOTNOTES:

[1] Except TDS which is in tons/day.
[2] Computed from PEL, 1979.
[3] Computed from Kennedy/Jenks, 1980.
[4] Excludes nitrogenous BOD.

DATA SOURCE: PEL, 1979; Kennedy/Jenks, 1980.

The ESP is designed to cause phosphorus-limiting conditions for algal growth which will leave nitrogen in excess.

The JWPCP under the ESP will contribute 50 percent or more of the total pollutant load in the Truckee River for nitrite, ammonia, total nitrogen, and orthophosphate.

The potential for ammonia and nitrite toxicity will be present given the estimated loading under the ESP. Reductions in downstream algal growth, resulting from the ESP phosphorus removal, may mitigate to some extent the risk for ammonia toxicity by moderating maximum pH.

Vista to Derby Dam

This reach of the Truckee River is characterized by faster velocities than upstream in the Truckee Meadows, a closed canyon geography, and minimal development.

Very few point source discharges exist. In the past, the SPPCo discharged cooling water to the river. This practice was discontinued in 1975 and now the cooling water is discharged to ponds along the river. The USGS monitors temperature upstream and downstream of the ponds to check for any effect of the ponds upon the river.

Quality conditions in this reach have been measured by several agencies. The results of the PEL sampling are shown in Table 4-17.

The long-term pollutant loadings measured at Vista and Clark by DRI are shown in Table 4-23. Nitrite, ammonia and organic nitrogen are not included due to incomplete data. From these data there appears to be a slight increase in phosphorus, both total and orthophosphate, TDS and chloride. Nitrate increases significantly, as would be expected due to nitrification (Figure 4-7).

Dissolved Oxygen. In general, data from PEL (1979) indicate a larger difference between maximum and minimum DO concentrations for this reach of the Truckee River as compared to other reaches. This difference is due to algal photosynthesis and respiration, and is characteristic of a nutrient enriched river.

Biochemical Oxygen Demand. BOD levels between Vista and Derby Dam typically remain stable or exhibit a slight decrease according to data collected by PEL (Figure 4-21).

Table 4-23. Water Quality Conditions at Clark; Average Load in lbs/day*

	Vista	Clark
Nitrate		
W[1]	686	1,131
S	491	1,055
Total Phosphorus		
W	895	1,059
S	948	1,066
Phosphate		
W	805	902
S	787	949
Total Dissolved Solids		
W	244	255
S	221	231
Chloride		
W	37,313	38,878
S	21,247	23,097

Footnotes:

* TDS in tons/day

[1] W = winter S = summer

DATA SOURCE: DRI, unpublished data; USGS.

Nitrogen and Phosphorus. Total phosphorus and orthophosphate (Figure 4-9) concentrations appear to be relatively stable in this reach. A second peak for both constituents occurred in three of the samples below Patrick. This peak may be due to cycling of nutrients or other phosphorus inputs in this reach. The DRI data show a slight increase in orthophosphate and total phosphorus in this reach which suggests other sources.

Ammonia concentrations decrease below Vista; however, unionized ammonia increased to a second peak in four of the six samples taken by PEL. This second peak is due to increases in pH in response to algal activity. The increased pH acts to shift more of the ammonia to the unionized state.

Nitrite and nitrate generally peak near Clark (Figures 4-7 and 4-22). Nitrate increases in this reach due to nitrification. Counteracting these increases are decreases due to algal uptake.

Periphyton. Periphyton biomass decreases between Vista and Clark according to PEL (Figure 4-8). Increases in biomass between Patrick and Clark were detected during the winter months.

Total Dissolved Solids. TDS concentrations show a slight increase in this reach (Figure 4-10). This is caused by the diversion and return of waters, and nonpoint sources such as runoff from soils.

Temperature. Diurnal temperature variations do not significantly change in this reach (Figure 4-11). The variation exhibited through the Truckee Meadows and below the JWPCP do not appear to occur in this reach. In two samples collected by PEL (February and August) a significant drop occurred in the minimum but not the maximum temperature.

Early Start Project. Under the ESP loading, water quality in this reach is expected to show improvement over existing conditions.

Orthophosphate concentrations will be reduced due to ESP phosphorus treatment and uptake by aquatic organisms. Nitrites and ammonia will be reduced in concentration below the discharge because of natural nitrification processes. The potential for toxic conditions will decrease in a downstream direction.

Nonpoint Pollution. Nonpoint source runoff to the Truckee River in this reach originates from the small amount of agriculture along the river in addition to on-site waste disposal, watershed erosion, and Interstate 80.

The exact magnitude of the nonpoint pollutant loading in this reach is unknown. From data collected by PEL (1979), slight increases in TDS, chloride and total phosphorus were noted between Vista and Clark. Total nitrogen decreased slightly for the average of the samples. In work done by the URS Co. (1978), the assumption was made that the agricultural acreage would remain constant in the next 20 years. Under this assumption agricultural pollutant loading to this reach would also remain about the same.

Pollution from urban sources has the potential for increasing as growth occurs in the Truckee corridor. On-site disposal systems are currently being used in the Truckee Corridor. In addition the Liberty Homes package sewage treatment plant is currently being constructed to handle a small development in the Mustang area. The package plant will utilize land disposal to a leach field located about 2,000 feet from the river (Tebeau, pers. comm.).

Derby Dam to Pyramid Lake

Derby Dam, located 20 miles downstream of Reno, was constructed as part of the Newlands Project to divert water via the Truckee Canal to the Carson River. This is the largest single diversion from the river and as such has a dominant effect on the flow in the river below Derby Dam; this is especially true when the majority of the river flow is diverted into the canal. The diversion controls flow during most of the year, except during floods, and therefore has a controlling effect upon the water quality within this reach. The timing of the diversion of flow to the lower river on the Truckee Canal can affect the distribution of nutrients to the two terminal reservoirs. The relative split of river water at Derby Dam during the months when PEL (1979) collected their data was:

Month	Flow at Vista in cfs	Percent of Vista Flow Diverted into Truckee Canal
Oct. 1977	61	86
Dec. 1977	118	78
Feb. 1978	488	100
May 1978	1,550	49
Jun. 1978	471	85
Aug. 1978	279	74

Aquatic habitat and fish in the lower river are subjected to considerable variation in both flow and water quality, depending on the split at Derby Dam. The relative effects of this split on downstream flow are described in the sections of this EIS on hydrology. When flow over the dam is low or absent, downstream water quality is primarily a function of the quality of the groundwater seeping into the river. When flow past the dam is large, e.g., May 1978, then the quality is essentially the same as the water quality above the dam. It is generally concluded that habitat in the lower river is influenced more by diversion at Derby Dam than conditions above Derby Dam. Consequently, the quality of habitat in the lower river is directly affected by JWPCP actions in a manner different than the upper river.

Accumulated silt and sediment have, at times, been flushed from behind Derby Dam into the lower river. This practice has had a serious effect upon the river below Derby Dam. DRI (1976) found that this flushing was detrimental to the macroinvertebrate population. This flushing, however, has not taken place since 1975. Flow velocity is lower and thus, the residence time of water is longer below Wadsworth than upstream. Consequently, sediments are more difficult to flush and nutrients entering the system have greater opportunity to recycle within the system. The PEL (1979) data suggest that nutrients in this reach are insufficient to meet algal growth demands.

Below Derby Dam several tributary springs flow into the river. Many of these springs were first noticed about 10 years after irrigation began on the benchlands at Fernley (Crowe, pers. comm.). A few of these springs and agricultural drains were sampled for water quality in June 1979 (Table 4-24 and Figure 4-23) (Crowe, pers. comm.). The sampling locations consist of a salt marsh, a spring, an agricultural drain, and a slough. These subsurface drainage sources introduce rather high concentrations of dissolved minerals to the river (Table 4-24). Conductance, for example, is extremely high in all four samples. These sources likely reflect to some degree the quality of irrigation return water from the benchland.

Within the river reach from Wadsworth to Nixon, groundwater plays an important role in contributing calcium, magnesium, and sulfate solutes to the river. During low flow periods, half of the solute load to the river is attributable to groundwater (Glancy, et al., 1972). It has been estimated that the net contribution of sodium, bicarbonates, and chloride solutes to Pyramid Lake from the river is on the order of 18,000-20,000 tons per year (Glancy, 1972).

Table 4-24

WATER QUALITY OF RETURN FLOWS TO THE TRUCKEE RIVER BELOW DERBY DAM

Location	Conductivity µmhos/cm	pH	Ca^{+2}+Mg^{+2} mg/l	Na^{+} mg/l	CO_3^{-2} mg/l	HCO_3^{-} mg/l	Cl^{-} mg/l	SO_4^{-2} mg/l	SAR mg/l
1	7,250	8.3	17.0	1,047	0	171	2,120	0	15.6
2	525	8.0	3.0	106	0	176	28	18.7	3.7
3	1,710	7.4	12.0	173	0	409	78	509	3.1
4	2,500	8.6	11.5	334	21	464	117	691	6.0

DATA SOURCE: Crowe, pers. comm.

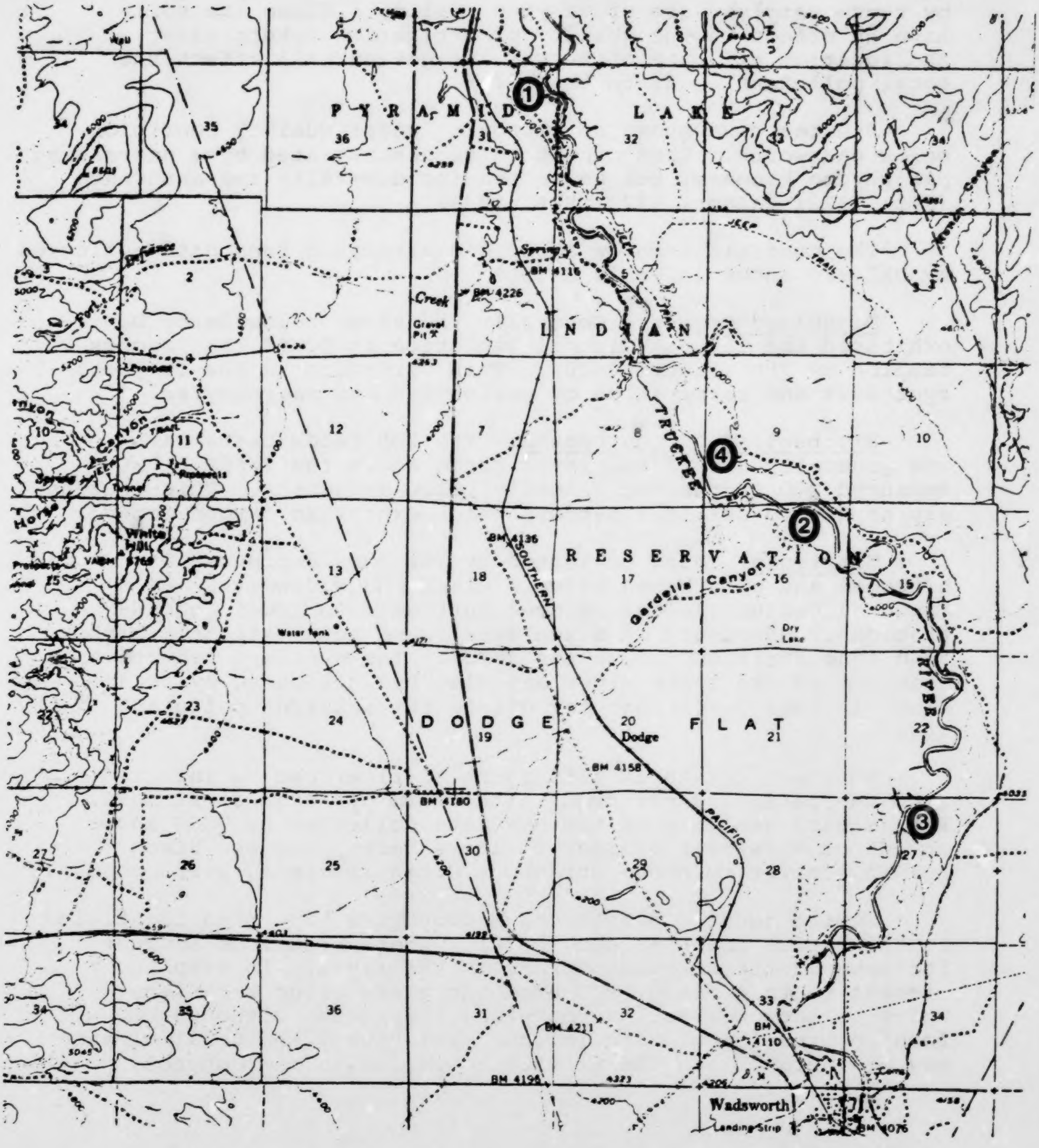


Figure 4-23. Water Quality Sampling Locations of Return Flows From the Fernley Benchlands

SOURCE: Crowe, pers. comm.

Soil samples were also collected from the reach below Wadsworth (Crowe, pers. comm.). The soils, as represented by these samples, are of varying quality. Since the soils have an effect on the quality of irrigation return water, the location and type of future irrigation will affect the total pollutant loads to the river.

Studies have shown an improving water quality condition below Wadsworth. This condition is demonstrated by a decreasing periphyton biomass, but an increasing diversity and abundance (PEL, 1979; Kaiser, 1973; EPA, 1971).

The conditions below Derby Dam estimated from data collected by DRI are shown in Table 4-25.

Dissolved Oxygen. Generally the river below Derby Dam exhibited the largest diurnal variation in DO of the reaches sampled by PEL (Figure 4-20). This variation is due to photosynthesis and respiration of periphyton and macrophytes.

Biochemical Oxygen Demand. The BOD below Derby Dam was generally around the level found above the JWPCP. PEL measured BOD increasing slightly below Wadsworth. This increase may be due to detrital matter, which exerts an oxygen demand.

Nutrients. Data collected by PEL show decreases in nitrogen and phosphorus between Clark and Wadsworth. By Nixon, algal uptake has reduced nutrients to lower concentrations. Nutrients at Nixon were found to be slightly higher than concentrations above the JWPCP. The nutrient reductions measured in the lower river may also be influenced by accretions in this reach that may dilute the existing pollutant load.

Nutrient uptake in this reach of river can be inferred from the data, and observed in the form of large algal mats. Preliminary analysis of the AGP data collected by USGS shows an AGP at Wadsworth similar to above Derby, but the Nixon AGP is similar to above Steamboat Creek (Hoffman, pers. comm.).

Rooted aquatic plants and macrophytes have been identified in this lower reach (Tiehn, 1978). These organisms account for some of the nutrient uptake in the river. In sampling biomass in this reach, PEL used the glass slide technique which selects against macrophytes; therefore, although PEL found decreasing biomass in the lower river, the total biomass may be increasing. The difference is due to macrophytes.

Table 4-25. Historical Wastewater Constituent Loads in the Truckee River below Derby Dam (lbs/day*)

		Below Derby Dam	Wadsworth	Nixon
NO_3	W[1]	616	608	553
	S	620	512	498
NO_2	W	33	41	27
	S	28	5	32
NH_4	W	373	307	213
	S	41	7	51
Org. N	W	155	1,025	847
	S	150	159	759
Total N	W	1,177	1,981	1,640
	S	839	683	1,340
Total P	W	291	359	375
	S	154	444	401
PO_4	W	278	307	278
	S	443	362	320
Chloride	W	13,730	15,030	31,340
	S	9,220	10,719	27,460
TDS	W	94	112	142
	S	101	117	142

* Pounds per day except TDS which is tons per day.

[1] W = winter S = summer

DATA SOURCE: DRI, unpublished data.

Measuring the total biomass is important because the nutrients temporarily stored in aquatic biomass will eventually enter Pyramid Lake. Nutrient uptake in this reach therefore is important in terms of river concentration and the achievement of standards, but not in terms of the total loading to Pyramid Lake.

Past studies have shown increasing diversity of macroinvertebrates between Wadsworth and Nixon (PEL, 1979; Kaiser, 1973; EPA, 1971). Species which are intolerant to organic enrichment comprise a larger percentage of the total population then they do at stations between Vista and Wadsworth. Kaiser (1973) found Class II organisms (mildly tolerant to pollution) to increase in importance from Wadsworth to Nixon.

Temperature. River flow during the summer and fall is generally low in this section of river. Low velocity and reduced canopy have contributed to high water temperature. These conditions often exceed state temperature standards, and also exceed the lethal level for the Lahontan cutthroat trout. Currently, water is being released from Stampede Reservoir during cutthroat trout spawning periods to help maintain water temperatures and flows suitable for spawning and hatching. The flow regime necessary to maintain a given temperature was derived by the USBR (Rowell, 1975). During times of the year when water is not being released for trout spawning, the water temperature becomes too high for trout. It is uncertain whether cui-ui or Lahontan cutthroat trout occupy the lower river during these warmer periods.

Nonpoint Pollution. The nonpoint source pollutants of this reach of the river are from agriculture, waste disposal systems, and soil characteristics. This reach of river was formerly part of the Pleistocene Lake Lahontan. As such, the soils contain salts deposited in the bottom material of this ancient terminal reservoir. Runoff from these soils dissolves and carries these salts to the river. Some of the runoff appears as springs or in drains, exhibiting quality as shown in Table 4-24. Some runoff returns to the river from diffuse sources. This returning runoff is quite high in salt content relative to the Truckee River at Clark (Table 4-24). Agricultural irrigation increases the quantity of runoff and duration of runoff, compared to occasional stormwater runoff.

Disposal of wastes from on-site sewage disposal systems such as septic tank leach fields also carries salts to the river and may also contribute nutrients.

There is a package treatment plant located in the Fernley area that utilizes an oxidation pond for effluent disposal. There also is a proposal for construction of a facility to handle a 10,000 unit development. This plant would utilize disposal to an aeration pond.

Early Start Project. Conditions in the lower river under the ESP reflect a phosphorus-limiting condition, with nitrogen in excess. Phosphorus concentrations will be at or near background levels for most of this reach. This occurs as a result of nutrient uptake in the Vista to Derby Dam reach and within the Derby Dam to Pyramid Lake reach. Total phosphate and total nitrogen loading under ESP is shown in Tables 5-2 and 5-3. Salt and chloride loads will increase in this reach due to seepage and direct return of agricultural waters and leachate from surrounding soils.

Currently, nutrient uptake into plant growth is a major process in this reach. The reported concentrations of nitrogen and phosphorus decrease to background levels by Nixon.

The AGP in this reach was measured recently by Lider, et al. (1980). The USGS is also currently conducting an AGP study. The DRI classified the river as nitrogen limited. Preliminary results from data collected by the USGS show a high background AGP at Wadsworth, but an AGP at Nixon similar to that measured above Steamboat Creek. Data collected by PEL also suggest that there is a nearly complete uptake of available nutrients in this reach.

Nitrogen will be in excess of algal use above Derby Dam with the ESP. Nitrogen levels passing Derby Dam should be high while O-PO_4-P should be less than 0.05 mg/l and limit the use of the available nitrogen. There are additional phosphorus inputs below Derby Dam from groundwater accretions. Once a steady-state condition is established in this lower reach as nitrogen is used in proportion to the added orthophosphate, a phosphorus-limiting condition should reestablish. Algal growth, it is thought, will still decrease from existing levels with the ESP. Nitrogen will still be in excess of algal needs and phosphorus will be the controlling nutrient in the lower river.

Pyramid Lake

Introduction. Pyramid Lake is a large, deep, saline-alkaline water body covering approximately 44,637 hectares (ha) (110,298 acres) (Harris, 1970, in Vigg, 1978b) in the Nevada Desert between the Lake and Virginia Mountain Ranges.

It is located some 50 kilometers (km) (31 miles) northeast of Reno on the Paiute Indian reservation. The surrounding terrain is extremely rugged along the northwest shore and gently sloping along the southwest. The Truckee River terminates in Pyramid Lake and is thus the lake's primary source of water. Small additional amounts of water enter the lake from snowmelt and from springs in the lake basin. The only outflow from the lake is evaporation. The total area tributary to the Truckee River and consequently draining into Pyramid Lake, including the Lake Tahoe basin, is about 5,976 km^2 (1,960 square miles) (Figure 4-1) (Glancy, et al., 1972). In addition to being the major source of water to the lake, the Truckee River supports other lake benefits. Among these assets are the importance of the river as a spawning area for the threatened Lahontan cutthroat trout (*Salmo clarki*), the endangered cui-ui (*Chasmistes cujus*), the Tahoe sucker (*Catostomus tahoensis*), and other organisms which spend a portion of their life cycle in the lake.

The climate of the Pyramid Lake basin is dry most of the year. Windy days are frequent, with winds occasionally reaching 65 km (40 miles) per hour. Daily temperatures range from -10°C-12°C in January and 10°C-35°C in July; extremes on record for the basin (measured at Nixon) are -30°C and 38°C (Kennedy, et al., 1977). Average annual precipitation is 15 centimeters (cm) (6 inches), including 25-30 cm (10-12 inches) of snowfall. The arid climate gives rise to an annual pan evaporation of 122 cm (48 inches) (Kennedy, et al., 1977).

Pyramid Lake is a remnant of the ancient Pleistocene Lake Lahontan. During the last glacial epoch, Lake Lahontan covered an area of 5,006,490 ha (12,371,036 acres) from west-central Nevada, north to the Oregon border (Russell, 1885, in Vigg, 1978b). The surface elevation of Lake Lahontan was as much as 183 m (600 feet) higher than the present surface elevation of Pyramid Lake. The surface elevation fluctuated widely throughout the centuries in response to climatic changes, and geologic evidence indicates that during the past several centuries the lake slowly receded due to long-term changes in climate. About 800 years ago the only portions of the basin containing water were Pyramid Lake and Winnemucca Lake. Until Winnemucca Lake dried up in 1938, these two lakes shared the entire natural flow of the Truckee River for several centuries (Pyramid Lake Task Force, 1971).

Limnology. Major physical, chemical, and biological characteristics of Pyramid Lake described in the references cited in this section are reviewed in Appendix H and summarized here.

Temperature. Water temperatures in the lake have been recorded to range from 0.6°C-25.5°C (Koch, 1973, in Vigg, 1978b). Lake temperatures ranged from about 6°C at the bottom in the fall and winter to above 23°C at the surface in mid-summer in 1976 and 1977. Isothermal (constant temperature with depth) conditions occur in early winter and wind-generated turbulence causes the lake to turn over (mix completely) in February-March. Temperature stratification takes place by June, following wind subsidence and an increase in surface water temperature, and a pronounced metalimnion (middle layer of decreasing temperature with depth) is formed at about 22 m (72 feet) which persists until December (Kennedy, et al., 1977; Galat, et al., 1979).

Dissolved Oxygen. DO has been found to range from less than 0.1 mg/l near the bottom in the deepest portion of the lake during fall to over 11 mg/l at the surface during June. DO was never lower than 5 mg/l in bottom waters during 1974 (Koch, et al., 1976). In 1976 the lowest DO concentration in surface waters, 8.1 mg/l, occurred in October, but the usual bloom of the blue-green algae Nodularia spumigena was smaller that year (Kennedy, et al., 1977). Reduced DO levels are usually coincidental with either blooms or with mats of decomposing Nodularia (Koch, et al., 1976). "With the exception of the very deepest part of the lake during the fall, dissolved oxygen concentrations are not limiting to fish" (Kennedy, et al., 1977). Galat, et al. (1979) found oxygen concentration minima of less than 2 mg/l in late fall in deep water (75-95 m).

Water Clarity. Secchi-disc visibility, a measure of water clarity, showed an average of 3 m and a range of between 1.2 m and 5.5 m (4-18 feet) in 1976 (Kennedy, et al., 1977). Transparency was lowest in August (Kennedy, et al., 1977) corresponding with the summer bloom of Nodularia. The euphotic depth averaged 11 m for both 1976 and 1977 (Galat, et al., 1979).

Hydrogen Ion Concentration. The hydrogen ion concentration (pH) ranged from 8.85-9.06 in 1974 (Koch, et al., 1976) and from 9.0-9.4 in 1976). There is apparently little variation by season or depth.

Specific Conductance and Total Dissolved Solids. Conductivity averaged 8,438 micromhos and ranged from 8,000 to 8,800 micromhos in 1976. Total dissolved solids (TDS) ranged from 4,985-5,385 mg/l and averaged 5,235 mg/l in 1976. Sodium chloride is the major TDS constituent (Kennedy, et al., 1977).

Nitrogen. In 1976 concentrations of epilimnetic (surface or open water) NO_3-N averaged 0.03 mg/l and ranged from less than 0.01 mg/l to 0.06 mg/l (Kennedy, et al., 1977). Similar concentrations were reported for 1977 by Galat, et al. (1979). Nitrate levels were stratified in summer. However, there was a short-term increase to 0.06 mg/l in 1977 following lake overturn which was quickly depleted to 0.01 mg/l (Galat, et al., 1979). Organic nitrogen occurred in the highest concentrations in surface waters, especially during August; lowest concentrations occurred during November. Inorganic NH_4-N ranged from less than 0.01-0.07 mg/l with maximum concentrations occurring in bottom waters when DO concentrations were below 1 mg/l. NO_2-N concentrations were highest during the early winter of 1976 at all depths with relatively small amounts present during late summer. Available nitrogen is most likely the primary limiting nutrient for nonnitrogen-fixing algae (Galat, et al., 1979).

Phosphorus. Concentrations of O-PO_4-P, the biologically usable form of phosphorus, ranged from 0.10 mg/l in February and March to 0.07 mg/l in September, averaging 0.0803 mg/l for 1976 (Kennedy, et al., 1977). The vertical distribution was similar to that of nitrate. As is characteristic of saline lakes in arid regions, total phosphate levels remained high throughout the year, showing an average of 0.10 mg/l. Epilimnetic total phosphate varied only slightly from a maximum of 0.11 mg/l in March to a minimum of 0.08 mg/l in October (Kennedy, et al., 1977). Similar data are reported for 1977 by Galat, et al. (1979). Algal growth assays conducted by Lider, et al. (1980) tend to confirm the assumed role of nitrogen and phosphorus. Phosphorus is not considered limiting to algal growth in Pyramid Lake.

Phytoplankton. The phytoplankton (floating algae) in Pyramid Lake consists of diatoms (26 genera), blue-greens (3 genera), and one green algal species (Kennedy, et al., 1977; Koch, et al., 1976). Diatoms dominate the phytoplankton from about May to September. Total phytoplankton abundance in 1976 increased from less than 40 cells per milliliter (cells/ml) to over 390 cells/ml by early August. Blue-green algae began to appear in late July. All genera decreased to lower numbers by late August.

Even though Pyramid Lake's phytoplankton production compares similarly with other saline-alkaline lakes, it is actually relatively small per unit volume because of the lake's depth and thus great volume (Galat, et al., 1977). Using trophic category criteria, Galat, et al. (1977) placed Pyramid Lake in the mesotrophic category, while in a 1979 report (Galat, et al.) the lake is classified as oligotrophic saline. He also noted that whether it is mesotrophic or oligotrophic depends on classification criteria. Fish productivity is considered high, however, because of efficient energy transfer from producer to consumer.

Primary Productivity. Galat, et al. (1977) recently analyzed the lake's annual organic matter budget and estimated it at 72,952 metric tons of carbon (m t C) or 0.789 grams of carbon per square meter per day (g C m^{-2} per day). Figures 4-24 and 4-25 show mean monthly relationships between solar radiation, chlorophyll a and gross productivity. Phytoplankton contributed 90 percent of this productivity, with the remaining 10 percent being contributed by wind-blown vegetation (6.5 percent), the Truckee River (3 percent), and benthic plants (less than 1 percent).

> "Much of Pyramid Lake's autochthonous[1] organic matter is produced during the annual summer Nodularia blooms (June-September). Living Nodularia is too large to be directly consumed by most Pyramid Lake zooplanktors. ...most of Pyramid Lake's allochthonous[2] productivity probably enters the detritus pathway. From here it is transferred to consumers." (Galat, et al., 1977).

Zooplankton. The zooplankton of Pyramid Lake consists of five species of cladocerans, one calanoid copepod, and one cyclopoid copepod (Kennedy, et al., 1977; Koch, et al., 1976). Kennedy, et al. (1977) found 75 percent of the zooplankton to be composed of copepods in 1976. Also, during that year, total zooplankton varied from a minimum of 21 individuals/liter in March to a maximum of 104 individuals/liter in June, with mean zooplankton numbers more than doubling in April. Also see Galat, et al., 1979.

Benthic Macroinvertebrates. In 1976 the benthic macroinvertebrates susceptible to quantitative dredge sampling consisted primarily of oligochaetes (64.4 percent) and chironomids (33 percent). Present were at least one genus of oligochaete, five genera of chironomids, two amphipods and two odonates, an unidentified leech and an unidentified water mite (Kennedy, et al., 1977). The greatest abundance of oligochaetes was found in October (average = 1,216 individuals per square meter [individuals/m^2]) and the lowest found in July (average = 549 individuals/m^2). Oligochaetes inhabited in greatest abundance zones ranging from 9-46 m and were least abundant from 0-8 m (Kennedy, et al., 1977). Chironomids were most abundant in April (average = 909 individuals/m^2) and least abundant in July. They were most numerous at 0-8 m (average = 656 individuals/m^2) and least numerous beyond 46 m (average = 10 individuals/m^2). Also see Galat, et al., 1979.

Bacteria (Thut, 1969, in Kennedy, et al., 1977) and detrital organic materials (Robertson and Alley, 1966, in Kennedy, et al., 1977), including organic matter from the Truckee River (Kennedy, et al., 1977), are probably the most important foods for the benthic macroinvertebrates.

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[1] From within the lake.

[2] From outside the lake.

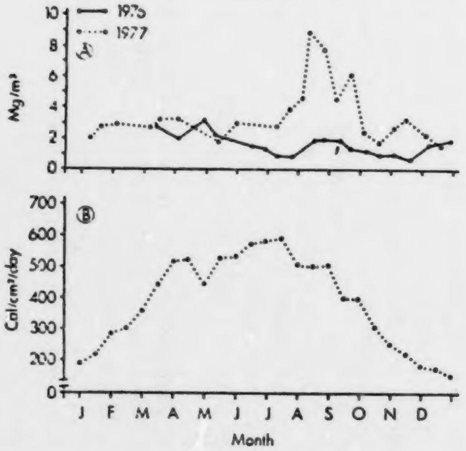


Figure 4-24. Mean Limnetic Chlorophyll a Concentrations (A) and Total Solar Radiation, Pyramid Lake, Nevada.

SOURCE: Galat, pers. comm.

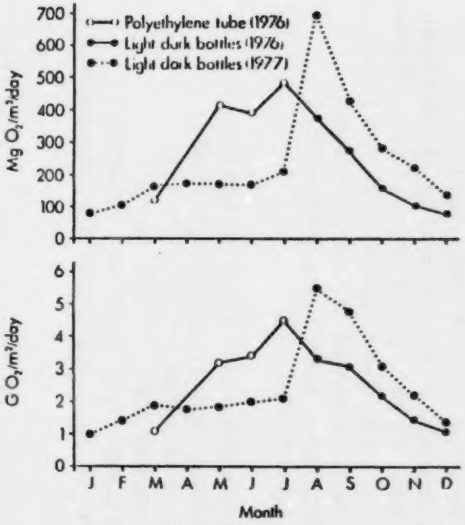


Figure 4-25. Mean Monthly Limnetic Gross Photosynthesis, Pyramid Lake, Nevada.

SOURCE: Galat, pers. comm.

Fish. The ten fish species in Pyramid Lake consist of the native cui-ui (Chasmistes cujus), a prehistoric remnant of the Pleistocene found only in Pyramid Lake; the native Lahontan cutthroat trout (Salmo clarki henshawi), largest of the cutthroat trout and a valuable game fish; the native Tahoe sucker (Catostomus tahoensis); the native Lahontan tui chub (Gila bicolor); the native Lahontan redside (Richardsonius egregius); the native speckled dace (Rhinichthys osculus); and the introduced rainbow trout (Salmo gairdneri); Sacramento perch (Archoplites interruptus); mosquitofish (Gambusia affinis); and carp (Cyprinis carpio) (see Appendix I, for life history information).

Birds. Several piscivorous birds rely on Pyramid Lake as nesting, rearing and feeding habitat. These species include: white pelican (Pelecanus erythrorhynchos), western grebe (Aechmophorus occidentalis), great blue heron (Ardea herodias), and common merganser (Mergus merganser). White pelicans are of special interest because the Pyramid Lake population of about 8,000 is the largest breeding colony in North America.

Major Ecological Concerns. There are major ecological concerns about the future quality of Pyramid Lake. All are affected by urbanization of the watershed, especially by water consumption, wastewater disposal, land erosion, surface runoff, and water project development. In relation to the JWPCP Master Project, direct and secondary effects of wastewater treatment and disposal may begin about 1985 when the 30 mgd ESP would phase into the 40 mgd Master Project. The preceding background data generally describe existing or recent conditions. A more thorough description is in Appendix H and the referenced documents.

The process of change reflecting total inflow from the Truckee River will continue, but as modified by governmental decisions influencing instream flow, erosion, wastewater treatment and disposal, nonpoint source pollutant management, and land use. Some near-term effects of the JWPCP in transition from the present to the 30 mgd ESP are identified here as the no-project condition.

Insufficient Inflow. Following 1906 and the beginning of water diversion from the Truckee River for irrigation in the Carson River basin, the inflow to Pyramid Lake decreased by about one-half. This led to an accelerated decline in the lake level over what would be expected due to natural climatic fluctuation alone. Increased water uses upstream also contributed to reduced Truckee River flow and the decline in lake level. Between 1906 and 1967 the lake level receded about 24 m, resulting from an annual water deficit between input and evaporation of about 475 thousand m^3 (Pyramid Lake Task Force, 1971) (Figure 4-26). The lake recovered 3 m between 1967 and 1974 as a result of alterations in the

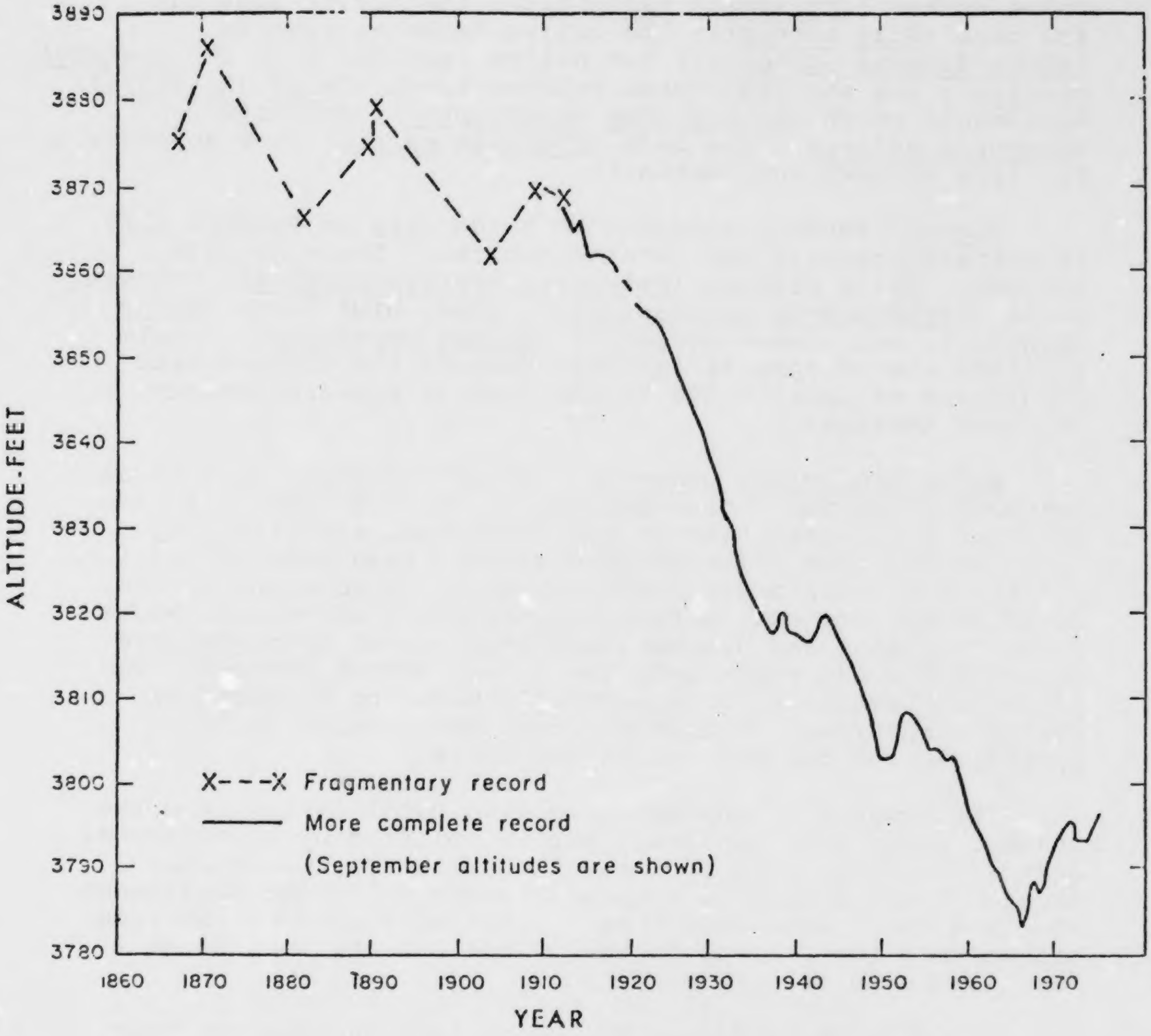


Figure 4-26. Water Surface Fluctuations of Pyramid Lake.

SOURCE: U. S. Department of Interior, 1977.

operating criteria for Truckee River water diversions and increased precipitation. At its 1976 level the lake represented a drop of 21 m from its 1905 surface elevation and a loss of approximately 11 billion cubic meters of water (Kennedy, et al., 1977) The lake level resumed its decline in response to the 1977-1978 drought years.

Lake level in the future will be a function of governmental decisions affecting water use in the Truckee River basin. The amount of Truckee River water diverted by TCID at Derby Dam is the major feature controlling lake level. The amount of water to be diverted is contested and in litigation (Appendix C). In the EIS analysis, flow in the system is exemplified by the 288,000 and 406,000 AFY scenarios (see Hydrology section of Chapter 4). Based on these scenarios, the amount of water entering the lake could vary by as much as 118,000 AFY or about 1 foot of depth on the lake in 1 year. Operation of the JWPCP with disposal to the river may have a small secondary impact on inflow to Pyramid Lake through increases in water consumption resulting from urban growth. The potential water consumption effects of urban growth are likely to be offset by the conversion of agricultural water to domestic uses. Within the next few years the conversion of agricultural land and water to urban use is expected to minimize the effects of urban water consumption on river flow; consequently, the no-project (ESP at 30 mgd) should not appreciably affect the amount of water reaching Pyramid Lake if water use rates continue as in the past.

The lowering of Pyramid Lake by about 21-24 meters since 1905 has severely impaired and possibly destroyed some of the lake's natural attributes. Just the loss of lake surface and volume has impaired it as a recreational, aesthetic, and natural resource. The economic value of the lake to its owners has been diminished.

The salinity concentration in the water has increased because of reduced freshwater inflow by about 33 percent, which narrows the spectrum of flora and fauna that occupy the lake. Anaho Island is endangered as wildlife habitat because of the possible development of a land bridge between the shoreline and the island. Instead of the Truckee River discharging to the lake through a well defined channel, it meanders across a large delta that prohibits and inhibits the free movement of fish between the lake and river. Blockage of natural passage between the lake contributed significantly to the endangerment of the cui-ui and the extinction of the Pyramid Lake strain of the Lahontan cutthroat trout.

The no-project option for the JWPCP may not in itself significantly affect inflow into the lake and the state of the impaired beneficial uses.

Sedimentation. Glancy, et al. (1972) collected hydrologic data to study the seasonal and areal character of stream flow, erosion, fluvial sediment movement, and solute transport. These hydrologic data were summarized and grouped according to periods of various stream flow conditions and compared with temperature and precipitation measurements recorded near Truckee, California, which served as conditions representative of the upper drainage basin where most of the runoff originated (Table 4-26 and Figure 4-27).

Glancy, et al. (1972) estimated the cumulative annual suspended-sediment load passing the Nixon gage to be about 51,709.55 metric tons (57,000 tons). Sediment bedload, which is not measured by suspended-sediment sampling, was assumed to have been about 10 percent of the suspended-sediment load, or about 54,431.10 metric tons (60,000 tons). The total sediment load passing the gage was therefore estimated at about 571,526.55 metric tons (630,000 tons) for water year 1969. Growth accommodated by the existing and ESP JWPCP may have some secondary effects on sediment loading through construction activities that disturb the soil and runoff from developed lands. Data have not been generated to assess the significance of this type of impact.

Increased Concentration of Solutes. Pyramid Lake water is currently highly ionic, being saline, alkaline, and basic. Nevertheless, the basic water chemistry of Pyramid Lake is quite stable in relation to chemical equilibria because the lake is a highly buffered bicarbonate system; this is confirmed by a pH which fluctuates only within a narrow range of about 8.8-9.4 throughout temporal changes that occur in the lake (Koch, et al., 1976).

It has been suggested (Lauer, 1933, in Robertson, 1978) that normally important controlling factors (e.g., temperature and dissolved oxygen) may not exert the same influence on aquatic populations in lakes of high salt content because of the overriding influence of salinity. More certain is the fact that high salinity reduces species diversity (Williams, 1972, in Galat, et al., 1977) which leads to less complex trophic relationships and potentially a less stable ecosystem. This more direct trophic structure also appears responsible for the efficient energy transfer which is the basis of the high fish production in Pyramid Lake (Galat, et al., 1977).

The deterioration of the Lahontan cutthroat trout and loss of the Sacramento perch fisheries in Walker Lake have been attributed to increased TDS levels (DOI, 1977). Bicarbonate and carbonate levels are believed to be limiting certain species of trout in Pyramid Lake (Knoll, and Koch, unpublished data, in Koch, et al., 1976). Experimentation with fertilized eggs of the cui-ui incubated in Pyramid Lake water (salinity = 5.2 mg/l, in two dilutions of the lake

Table 4-26

SUMMARY OF PRECIPITATION AND AIR TEMPERATURE AT TRUCKEE, CALIFORNIA, AND HYDROLOGIC AND WATER QUALITY CONDITIONS FOR TRUCKEE RIVER NEAR NIXON, NEVADA WATER YEAR 1969

(precipitation and air temperature for National Weather Service station at Truckee Ranger Station)

PERIOD NUMBER	PERIOD	TOTAL PRECIPITATION (in)	AVERAGE AIR TEMPERATURE (°C)	AVERAGE DISCHARGE (cfs)	TOTAL ACRE-FEET	ESTIMATED AVERAGE SUSPENDED-SEDIMENT CONCENTRATION (mg/l)	ESTIMATED TOTAL TONNAGE OF SUSPENDED SEDIMENT	AVERAGE SPECIFIC CONDUCTANCE (micromhos per cm at 25°C)	TOTAL TONNAGE OF SOLUTES[1]	TONNAGE OF SODIUM PLUS EQUIVALENT BICARBONATE AND CHLORIDE[1,2]
1	10-1 to 12-21	8.45	2.0	44	7,200	14	140	690	4,000	1,800
2	12-22 to 1-19	8.43	-3.5	480	27,500	40	1,500	300	7,200	2,500
3	1-20 to 1-31	15.47	-5.5	2,530	60,300	1,200	100,000	240	13,000	4,300
4	2-1 to 2-28	9.57	-5.0	1,630	90,600	210	26,000	180	15,000	4,700
5	3-1 to 3-31	1.56	-1.0	2,200	135,000	350	65,000	140	18,000	5,100
6	4-1 to 6-30	5.23	8.5	3,440	620,000	450	380,000	110	68,000	17,000
7	7-1 to 7-31	.90	16.0	430	26,300	81	2,900	210	4,900	1,700
8	8-1 to 9-30	.10	14.5	50	6,000	19	150	660	3,200	1,300
	ENTIRE YEAR	49.79	6.0	1,340	974,000	430	570,000	144	133,000	39,000

1. With bicarbonate multiplied by 0.492 to make results comparable with "residue on evaporation' values.

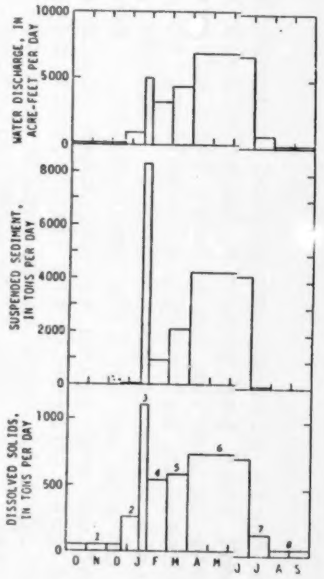
2. Tonnages are based on combined milligram-per-liter concentrations calculated as follows: sodium and chloride are totaled along with an amount of bicarbonate that is equivalent (on a reacting-value basis) to the amount by which sodium exceeds chloride; that is, me/l (milliequivalents per liter) HCO_3 = me/l Na - me/l Cl.

SOURCE: Glancy, et al., 1972.

Figure 4-27

STREAM FLOW, SUSPENDED-SEDIMENT LOAD, AND SOLUTE LOAD CARRIED BY TRUCKEE RIVER NEAR NIXON DURING WATER YEAR 1969

(numbers correspond with periods listed in Table H-2)



SOURCE: Glancy, et al., 1972.

water (salinities of 3.8 and 1.8 mg/l), and in fresh well water show that although some cui-ui eggs could hatch in the lake water with a salinity close to 1.8 mg/l hatching success diminished as salinity approached 3.8 mg/l. Additionally, a significant decrease in egg size and mean total length of larvae occurred as salinity increased (Chatto, 1979).

The facts already presented concerning the recession of ancient Lake Lahontan to form Pyramid Lake and the climatic conditions conducive to a high rate of evaporation imply that increasing salinity, a corollary to a receding water level, is a natural phenomenon. Records do not indicate rate of change so it is a moot point. However, the lowered water inflow and salinity increase was accelerated between 1906 and 1967 widening the difference between the amount of water lost through evaporation and that entering from the Truckee River and from precipitation.

Since the beginning of the operation in Derby Dam in 1906, TDS has increased from 3,924 mg/l to the 1976 mean total concentration of 5,235 mg/l and ranges of 4,985 to 5,384 mg/l (Kennedy, et al., 1977). The major constituents are sodium, potassium, bicarbonate and chloride ions, with sodium and chloride dominating (Kennedy, et al., 1977). Sodium chloride accounted for 68 percent of this total in 1976 (Lider, pers. comm., in Vigg, 1978b).

Measurements of the concentration of dissolved solids in samples collected at the Nixon gage during the 1969 water year ranged from 80 to 45 mg/l (Glancy, et al., 1972). The highest concentrations occurred during low flow periods when more than half of the dissolved solid load was contributed by saline groundwater entering from approximately 23 miles (37 km) upstream from Pyramid Lake. These low flow waters were dominated by sodium and almost equal amounts of calcium, bicarbonate, and chloride. The most dilute waters, consisting primarily of snowmelt, coincided with periods of highest flow. These dilute waters contained mostly silica, calcium, sodium, and bicarbonate (Glancy, et al., 1972).

The solute load carried by the Truckee River past the Nixon gage in 1969 ranged from 45.36 metric tons (50 tons) per day during low flow periods to about 997.90 metric tons (1,100 tons) per day during the latter part of January. The load averaged 662.25 metric tons (730 tons) per day during the period of April-June when high flow was sustained. "The first major runoff of the year tends to flush out solutes that have become available during the previous period of low flow" (Glancy, et al., 1972). The total load for 1969 was about 117,934 metric tons (130,000 tons). This total annual solutes load is about one-fifth of the sediment load for the year.

Glancy, et al. (1972) estimated the quantity of solutes passing the Nixon gage in an average year to be 40,823.33-49,895.18 metric tons (45,000-55,000 tons) and the average concentration to be about 150 mg/l. This estimated annual average income of principal solutes from the Truckee River to Pyramid Lake is equal to about one seven-thousandth of the lake's current salt content of 127.01 million metric tons (140 million tons).

Because solutes contributions from the Truckee River would increase the tonnage in Pyramid Lake by less than 1.5 percent in 100 years at present day rates of income (Glancy, et al., 1972), it appears evident that the primary cause of salinity increase in Pyramid Lake since 1905 has been solute concentration accompanying evaporative water losses which were not compensated for by freshwater inflow.

Effluent from the 30 mgd ESP will contain more TDS than the influent. This increase in TDS due to sewage and waste-water treatment is a minor portion of the 45,000-55,000 tons of solute annually entering the lake.

Blue-Green Algae. The blue-green algae Nodularia spumigena typically forms late summer algal blooms in Pyramid Lake. However, it does not appear to produce any toxins that are detrimental to any of the lake biota, including zooplankton or other algae (Koch, et al., 1976), nor does it create life-threatening anoxic conditions during decomposition. The only detrimental effect the algae appears to exert is the physical stress of crowding on zooplankton and larval fish (Koch, et al., 1976). Both field and laboratory investigations showed that Moina hutchinsoni, a preferred food for planktivorous fish, reproduces well during those months when Nodularia blooms. Although blue-green algae have not represented a problem there is concern that accelerated nutrient loading will increase the risk for a blue-green algae problem.

Nutrient Loading. As a terminal lake, concentrations of nutrients in Pyramid Lake can only increase. Large nitrogen and phosphorus reservoirs are maintained in the flora and fauna and detritus in the lake, and normal decomposition releases these nutrients in amounts that vary with season. Additionally, there is a continuous flow of nutrients into the lake in Truckee River water and suspended particulate matter. These nutrients, expecially those stored in detrital materials and plants can greatly augment the average loadings to the lake during scouring following heavy runoff. For example, Glancy, et al. (1972) found the heavy runoff in water year 1969 to cause extensive erosion in the Truckee River basin. Scouring of the river moves stored organic matter downstream into the lake. This load accounts for an undetermined part of the allochthonous carbon, and also nutrient inflow. Although dissolved nitrogen and other micronutrients flowing into the lake may enter almost immediately into the energy flow, organic materials are metabolized in the lake and their entry into the steady-state energy flow system may require considerable time. It seems appropriate to conclude that any nutrient inflow accelerates eutrophication processes in the lake.

There is little historical data on nutrient loading to Pyramid Lake. Data on nitrogen and phosphorus concentrations in the lake prior to 1973 appear to be nonexistent. However, some general knowledge is available regarding current sources and concentrations of major nutrients.

Nitrogen. Autochthanous nitrogen sources are primarily nitrogen fixation by blue-green algae and subsequent mineralization. Allochthanous sources are primarily importation from the Truckee River, precipitation, and windblown dust and vegetation. However, it is not known how much of the total nitrogen entering the lake is converted to biologically usable nitrate (NO_3) (Galat, pers. comm.). Nitrogen is a limiting nutrient for algae; consequently, any inflow of soluble nitrogen is expected to quickly enter the photosynthetic process. Over the period of a year or more the lake responds to the total nitrogen load.

Under existing conditions, the average annual total nitrogen load was estimated to be 3,781 pounds per day, of which 1,784 pounds per day originates from the JWPCP (Table 4-25). Complete use of the 30 mgd ESP plant will increase the total nitrogen load to either 7,310 or 5,593 pounds per day, depending on the TCID operating criteria of 288,000 or 406,000 AFY. Expansion to the 30 mgd JWPCP would account for about 49-61 percent of the increase in load. Using the maximum loading scenario as an example, i.e., the 30 mgd JWPCP and the 288,000 TCID criteria, the JWPCP would contribute about 62 percent of the average daily load.

As noted earlier, any soluble nitrogen entering Pyramid Lake probably goes immediately into algal growth. The concentrations of algae presently in the lake and observed in recent studies is assumed to represent this response plus the long-term reflection of total nitrogen load. The increase in total nitrogen load of possibly 1,812 pounds per day (0.67 grams/m^2/yr) between 20 mgd and 30 mgd of effluent may, over a period of years, stimulate noticeable increases in algal bloom density.

Phosphorus. The major source of phosphorus is most likely geologic, as phosphorus deposits occur all around the lake. However, it is not known how much of this is transformed into biologically useful orthophosphate (Galat, pers. comm.). Phosphorus is not considered a limiting nutrient.

Much indirect evidence points to nitrate as the primary limiting nutrient for algae in Pyramid Lake, except for the nitrogen-fixing blue-green algae (Galat, pers. comm.). Culture experiments on Nodularia showed it to be phosphorus-limited in Pyramid Lake water. However, orthophosphate does not disappear from the water during Nodularia blooms as would be expected if it were limiting in the lake.

> "It is my opinion that phosphates in part limit Nodularia in Pyramid, but other factors, primarily temperature, are equally important. Nitrates and silicates appear to be the probable limiting nutrients for other Pyramid Lake algae. Generally speaking, phosphate levels in Pyramid are quite high while nitrate concentrations are quite low. Pyramid's inorganic nitrogen to orthophosphate ratio of 1:2 further suggests nitrate as the dominant limiting nutrient to non-nitrogen fixing algae" (Letter from D. Galat, Colorado Cooperative Fish Unit, 22 December, 1978, to R. Ryder, Pacific Environmental Laboratory).

The total phosphorus load (TP) is estimated to be 587 pounds per day (0.22 grams/m^2/yr). Full utilization of the 30 mgd ESP, which includes phosphorus removal in the treatment process, could lower this load to about 153 pounds per day (0.06 grams/m^2/yr) at the 406,000 TCID level of water diversion.

Since nitrogen appears to be the limiting nutrient, at least insofar as the nitrogen to phosphorus ratio is concerned, the estimated 74 percent reduction in total phosphorus load is not expected to observably affect algal blooms in the lake.

Loss of Native Fishes. Prior to 1905 and the construction of Derby Dam, Pyramid Lake supported a productive fishery consisting of many large Lahontan cutthroat trout and the cui-ui sucker. Historically these fish were a major food for the Indians, who did not engage in extensive agriculture (Pyramid Lake Task Force, 1971). However, by 1929 the Lahontan cutthroat and cui-ui could no longer migrate up the Truckee River where they traditionally spawned. The decline in lake level and reduced Truckee River flow had combined to create a silt delta at the river mouth with insufficient water depth in delta channels to permit fish navigation. By 1940 the Lahontan cutthroat fishery was nonexistent and the cui-ui was reduced to the status of an endangered species (Pyramid Lake Task Force, 1971).

The cui-ui was first listed as an endangered species in the Federal Register on March 11, 1967. A recovery team has been assigned and a recovery plan prepared (USFWS, 1978) for this species, although critical habitat is still under consideration by the U. S. Fish and Wildlife Service (USFWS). Although the cui-ui was once abundant, it now comprises less than 1 percent of the fish in Pyramid Lake (Letter from K. Schreiner, Acting Director USFWS, 23 August, 1978 to D. Costle, Administrator EPA). Except for spawning in the lower Truckee River between the lake and Derby Dam, the cui-ui's habitat consists of the littoral zone of the lake, mainly at depths of 0-5 m (Vigg, 1978a, in Vigg, 1978b). It has rarely been found at 23 m, never deeper than 46 m, and the only surface catches have occurred during the spring spawning season (Vigg, 1978a, in Vigg, 1978b). The cui-ui were found to be considerably less abundant in 1969 than previously and during the fall of that year the Indians closed the fishery to non-Indians. Good progress has been made, however, with recent artificial spawning procedures to return juvenile cui-ui to the lake to strengthen the existing population.

No evidence was found to indicate that nutrient inflow to the lake harms the cui-ui; however, decreased river discharge and sedimentation have blocked passage from the lake to the river which is a principal cause of the endangerment of the species. The Marble Bluff fishway was installed in 1975 to partially mitigate these effects. Urban growth between the present and full use of the 30 mgd ESP, the no-project alternative, is not expected to significantly change present conditions of river discharge to the lake.

The Lahontan cutthroat trout population in Pyramid Lake was at one time large enough to support a large commercial fishery. However, the fish was listed as an endangered species on October 13, 1970. It was later reclassified as a threatened species on July 16, 1975. The largest population of the Lahontan cutthroat currently exists in Pyramid Lake. Lahontan cutthroat were found predominantly on the bottom throughout 1977, and they apparently prefer areas ranging in temperature between 7°C and 15°C (Vigg, 1978a, in Vigg, 1978b).

In attempting to reestablish the Pyramid Lake fishery, Congress passed the Washoe Project Act in 1956. This led to the construction of Marble Bluff Dam and Fishway at the mouth of the Truckee River by the Bureau of Reclamation to provide a passage around the delta for spawning fish and help control erosion. Together with related work, the Washoe Project has also supplied hatchery-produced fish for supplemental stocking. As a result, the Lahontan cutthroat trout population has increased and contributes significantly to the lake's sports fishery by producing trophy-sized fish.

In addition to the cui-ui and Lahontan cutthroat, the bottom (23 m) inshore area of Pyramid Lake is the habitat for three other fish species; Lahontan tui chub, Tahoe sucker, and the Sacramento perch. In contrast to this diversity in the inshore bottom area, the tui chub alone accounted for over 98 percent of sampling catches in inshore surface and offshore open-water areas in 1977; the remaining 2 percent consisted primarily of the Lahontan cutthroat (Vigg, 1978b).

Concern has been expressed that nutrient loads, especially nitrogen entering the lake, will cause eutrophic conditions harmful to the indigenous fishes.

Threat to Anaho Island Fauna. Anaho Island is a national wildlife refuge within Pyramid Lake. It is administered by the USFWS for the purpose of protecting colonial nesting birds. Of the total of 303.5 ha occupied by the island, 100 has are devoted to the refuge. The island has one of the largest white pelican colonies of the United States. Also inhabiting the island are colonies of double-crested cormorants, California gulls, great blue herons and Caspian terns. The total summertime population of waterbirds reaches approximately 15,000 individuals (DOI, 1977).

The declining lake level has exposed more of the island. Whether these areas can be considered a part of the refuge or are technically part of the Indian reservation is as yet undetermined. Most of the bird nesting occurs on these recently exposed areas. Additionally, a natural land bridge connecting the island to the shore now lies only about 9 m below the water surface. Exposure of the bridge would enable both humans and natural predators access to the island, posing a threat to the continued existence of the bird rookeries and to the various other animal inhabitants (DOI, 1977).

Any diminishment of the average annual Truckee River discharge to the lake exacerbates the threat to Anaho Island. The no-project option to 30 mgd does not appear to significantly alter river discharge. The data that are available are too imprecise to reveal the magnitude of either positive or negative effects.

Truckee Canal

Kennedy/Jenks (1980) presented water quality data for the Truckee Canal as collected by PEL and other groups (Table 4-27).

Table 4-27

TRUCKEE CANAL WATER QUALITY

Parameter	Units	Below Derby Dam - 9/68 (1)		At Fernley - 10/77 - 8/78 (2) 7/28/72 (3)		At Hazen - 7/28/72 (3)		Above Lahontan Dam - 7/72-3/75(3) 11/74-11/75 (4)		R/S JWPCP Effluent (5)
		Conc.	# of Samples	Conc.	# of Samples	Conc.	# of Samples	Conc.	# of Samples	
Total-P	mg/l	0.73	1	0.91	6	-	-	0.23	14	0.4
Ortho-P	mg/l	0.64	1	0.73	7	0.71	1	0.25	32	-
Diss. Ortho-P	mg/l	-	-	-	-	-	-	0.16	13	-
Total-N	mg/l	-	-	3.84	6	-	-	-	-	21.5
NH_3-N	mg/l	0.37	1	0.57	6	-	-	0.08	14	16
NO_3-N	mg/l	0.62	1	1.7	7	0.66	1	0.45	32	1.0
NO_2-N	mg/l	-	-	0.11	6	-	-	-	-	1.5
NO_2-N plus NO_3-N	mg/l	-	-	-	-	-	-	0.23	14	-
Total Kjeldahl-N	mg/l	-	-	-	-	-	-	1.08	14	-
Organic-N	mg/l	0.31	1	1.4	6	-	-	-	-	-
BOD_5	mg/l	-	-	2.7	6	-	-	-	-	4
Zinc	mg/l	-	-	0.025	6	-	-	-	-	0.073
TDS	mg/l	145	1	193	7	228	1	160	32	324
pH	Unit	7.2-8.1	7	7.2-8.7	15	-	-	-	-	-
Temp.	°C	17-21	7	6-22	15	-	-	-	-	-

NOTES:

(1) EPA, Region IX, "Water Quality Data, Truckee and Carson Rivers, Pyramid Lake, and Lahontan Reservoir, A Working Paper", 1971.
(2) Pacific Environmental Laboratory, "Effects of the Reno/Sparks Joint Water Pollution Control Plant on Water Quality of the Truckee River", 1979.
(3) DRI, water quality data stored in computer, 7/72-3/75.
(4) EPA, water quality data stored in STORET computer data retrieval syste, 1974-75.
(5) R/S JWPCP effluent with PhoStrip treatment, and filtration.

Apparent discrepancies in concentrations of certain constituents are due to the averaging of different sets of water quality data.

SOURCE: Kennedy/Jenks, 1980.

A comparison of the PEL data for the Truckee Canal and the Truckee River at Clark shows that the quality conditions are similar for the two locations (Table 4-23).

The average total nitrogen concentration in the Truckee Canal is slightly less than in the Truckee River at Clark, while total phosphorus concentrations are equivalent. Individual nitrogen forms varied between Clark and the Truckee Canal. Ammonia, for example, was always less in the canal than at Clark. Nitrate, on the other hand, was present at much greater concentrations in the canal than in the river.

It appears that nutrients are taken up in the Truckee Canal (Table 4-27). The magnitude of this uptake is unknown. It is expected to be less than the rate of uptake in the river, however, due to the physical characteristics of the canal.

A recent AGP test conducted by the USGS for the Truckee Canal at Fernley and above Lahontan Reservoir showed only a slight increase in algal growth between Fernley and Lahontan (Hoffman, pers. comm.). The results of this particular test have not been fully examined to determine any trends. A second sample was undertaken in July 1980, and a third sample is scheduled for August 1980. It is hoped that these tests will clarify the nutrient uptake characteristics in the Truckee Canal.

The pollutant loads in the Truckee River at Clark are divided between the Truckee Canal and the lower Truckee River by the diversion at Derby Dam. The relative quantities of nitrogen and phosphate diverted into the Truckee Canal are estimated in Tables 5-4 and 5-5.

The JWPCP accounts for a large portion of the total nitrogen load. It accounts for less than half of the total phosphorus load, under the ESP.

Nitrogen conditions in the canal will be high due to nitrogen being in excess. Within the Truckee Canal, as in the Truckee River, phosphorus will be limiting.

Present loads at the terminus of the Truckee Canal for total nitrogen and phosphorus are 1,947 and 468 pounds per day, respectively. Under ESP conditions, total nitrogen and phosphorus loads will be from 710-2,183 pounds per day and 19-60 pounds per day, respectively. The actual load will depend on whether the 288 or the 406 criteria are adhered to. These calculated loads for total phosphorus reflect the phosphorus removal characteristics of the ESP.

Water Quality Standards. Water quality standards for the State of Nevada adopted by DEP state that "criteria so specified apply to all surface waters of Nevada in the watershed upstream from the control point, or to the next upstream control point...". From this it may be inferred that the water quality standards for Lahontan Reservoir also apply to the Truckee Canal. Beneficial uses which govern standards would also apply to the canal (Tebeau, pers. comm.).

The current beneficial uses for Lahontan Reservoir are water contact sports, fish and wildlife habitat, power generation, irrigation, and aesthetics.

Algal Growth Potential. The testing of AGP in the Truckee Canal is currently being considered by the USGS. Preliminary results indicate that the AGP in the canal is higher than background conditions above the JWPCP and that some degree of nutrient uptake occurs in the canal.

Under the ESP, algal growth in the canal should be slightly less than current conditions because of the phosphorus limitations.

Lahontan Reservoir

Lahontan Reservoir is located on the Carson River approximately 72 km (45 miles) southeast of Reno (Figure 1-1). It is 27 km (17 miles) long and of variable width. The reservoir has a surface area of 5,099 ha (12,600 acres) and 104.5 km (65 miles) of shoreline when full. Its maximum depth is 34 m (112 feet).

The water stored in Lahontan Reservoir originates from the Carson River and, via diversions created by Derby Dam and transported by the Truckee Canal, from the Truckee River. An historical account of the development of Lahontan Reservoir can be found in DOI (1977).

The contribution of Truckee Canal water to the total inflow of Lahontan Reservoir varies greatly with the water year, and will likely change with future competing demands for Truckee River water. Truckee Canal inflow was about 25-35 percent of annual outflow from Lahontan Reservoir in 1973-1975. During the drought years of 1976-1977, Truckee Canal inflow was over 200 percent of reservoir outflow (estimated from published and unpublished USGS and TCID data). Most flow from the Truckee Canal to Lahontan Reservoir occurs during the nonirrigation season (November-March). Flows in the canal during the irrigation season are nearly all diverted to service areas along the canal.

Truckee Canal Inlet to Lahontan Reservoir.

Table 4-28

SUMMARY OF AVAILABLE ALGAL NUTRIENT DATA FOR LAHONTAN RESERVOIR
(From 7/66-5/76)

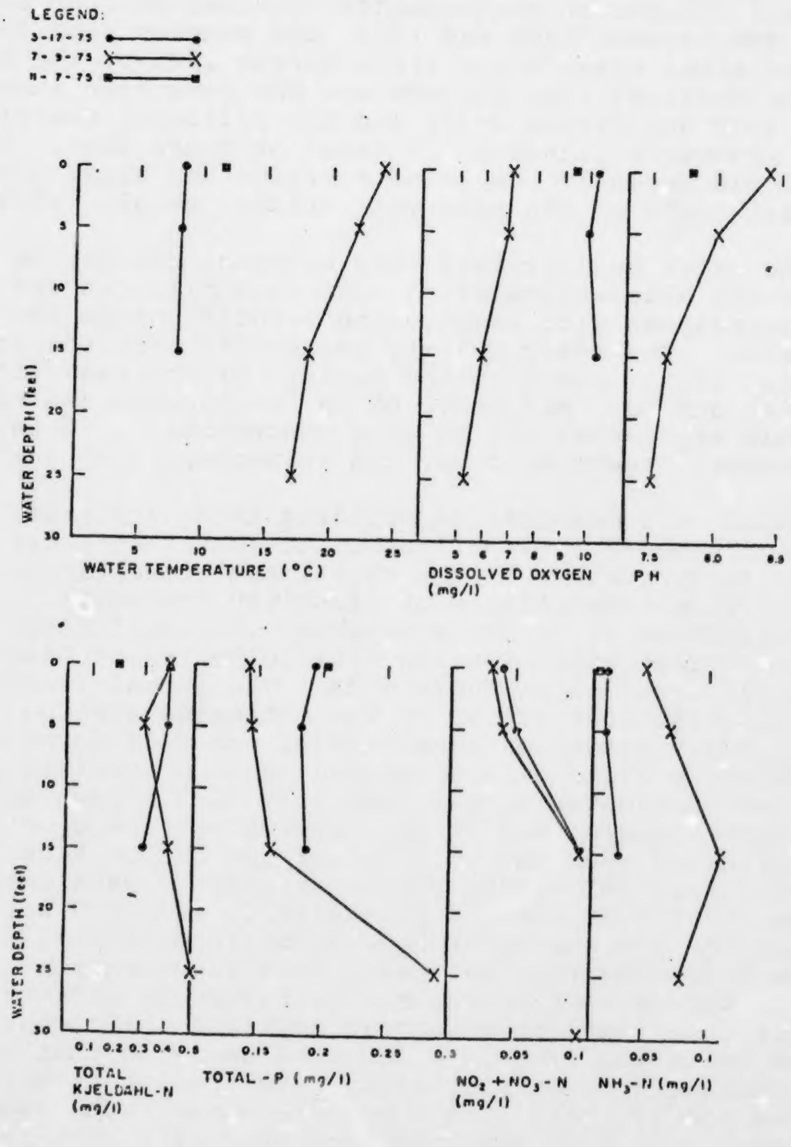
Station	Phosphates						Nitrate		
	Number of Samples	Total		Number of Samples	Ortho		Number of Samples		
		Range	Average		Range	Average		Range	Average*
Near Dam	19	0.30-1.60	1.11	14	0.28-1.55	0.69	20	Neg.-10.5	1.72
Near the Narrows	19	0.14-1.36	0.53	14	0.13-1.05	0.49	20	Neg.-4.8	1.33
Near Silver Springs Beach	18	0.20-1.06	0.56	14	0.23-0.85	0.55	19	Neg.-4.8	1.16
Near River Mouth	15	0.28-0.80	0.51	12	0.28-0.76	0.48	15	Neg.-1.7	0.63

*Averages are calculated with concentrations reported as trace, neg., and <0.4=0.

SOURCE: Carson River Basin Council of Governments, 1978.
Carson River Drainage (Nevada) Areawide Wastewater Management Planning Program, Phase I Report (beneficial uses, criteria).

Figure 4-28

VARIATIONS OF WATER QUALITY PARAMETERS
IN
LAHONTAN RESERVOIR AT EPA STATION 320204



SOURCE: Carson River Basin Council of Governments, 1978. Carson River Drainage (Nevada) Areawide Wastewater Management Planning Program, Phase I Report (beneficial uses, criteria).

Power is generated by a SPPCo facility at the end of outlet pipes below the reservoir. There are also penstocks to the power plant that come directly from the Truckee Canal. The canal penstocks are rarely used, however, because use of them is only permitted during the irrigation season, and there is rarely enough water flowing at the end of the canal during the irrigation season.

Limnology. Water quality data available for Lahontan Reservoir consist of measurements obtained at four sites by the NDW between 1966 and 1967, and samples from 3-4 depths at three sites taken three times during 1975 by the EPA. The data obtained from the NDW and EPA have been summarized (Table 4-28 and Figure 4-28) and the following description of the reservoir limnology is based on these data. Also, the DRI has recently completed nutrient and algal growth potential tests on the reservoir (Lider, et al., 1980).

The water quality data show seasonal changes in DO, pH, and the algal-stimulating nutrients nitrogen and phosphorus, which correspond with temperature stratification and destratification. The water quality parameters with the greatest potential significance to the biology of the reservoir are nutrients and DO. Midsummer DO in the hypolimnion of the reservoir approaches the minimum concentration (5 mg/l) required for adequate growth by trout and warmwater sport fish.

Based on concentration criteria (EPA, 1976) for classifying lakes and reservoirs as oligotrophic (nutrient poor), mesotrophic (moderately nutrient rich), and eutrophic (nutrient rich), 1976 concentrations of dissolved phosphate in Lahontan Reservoir place it in the eutrophic >.025 mg/l category. Recent nutrient concentration data collected by Lider, et al. (1980) is shown in Table 4-29. The annual loading rate of total phosphorus (Total P) was estimated (CRBCOG, 1978) to be 1.8-2.9 grams per square meter per year (grams/m^2/yr). This range is based on minimum and maximum possible retention times for phosphorus in the reservoir of 0.6 year and 1.0 year, respectively, and on USGS hydrographic and water quality data collected near the entrance of the Carson River to the reservoir from 1971-1976, USGS hydrographic data for the Truckee Canal near Hazen for 1966-1975, and USGS water quality data for the Truckee River near Nixon from 1974-1976. The minimum retention time was calculated assuming that the Truckee Canal discharge short-circuits the reservoir and therefore does not contribute to reservoir nutrient enrichment. The maximum retention time is calculated assuming that the Truckee Canal discharge mixes completely with the water in the reservoir. The true loading rate lies somewhere between the two extremes. The annual supply of Total P which typically constitutes eutrophic conditions is 0.51-0.65 grams/m^2/yr (EPA, 1976).

Table 4-29. Background Nutrient Analyses of Water Collected at Two Stations in Lahontan Reservoir During Four Sampling Dates. (Samples Were Autoclaved and Filtered, .45 Microns Prior to Chemical Analysis) (Values in mg/l)

	Ortho-Phosphate (P)	Total Phosphate (P)	Ammonia (NH_4-N)	Nitrite (NO_2-N)	Nitrate (NO_3-N)	Total Kjeldahl Nitrogen (N)
Carson River Arm-LR-1						
April 1979	0.12	0.14	0.08	0.01	0.25	0.39
August 1979	0.26	0.27	0.08	0.01	0.01	0.50
December 1979	0.04	0.27	0.12	0.15	0.10	0.60
February 1980	0.11	0.18	0.02	0.03	0.18	0.82
Dam-Truckee Canal-LR-2						
April 1979	0.21	0.22	0.08	0.02	0.64	0.46
August 1979	0.13	0.23	0.06	0.01	0.01	1.10
December 1979	0.23	0.27	0.14	0.02	0.74	0.60
February 1980	0.23	0.26	0.09	0.01	0.83	0.68

SOURCE: Lider, et al., 1980.

Nitrate is considered to be the limiting nutrient in Lahontan Reservoir (CRBCOG, 1978 and DRI, 1980) and would appear to be so, based on EPA data. However, the NDW data show nitrate concentrations too high to be limiting. The most recent available concentration of NO_3-N in the reservoir recorded by NDW is 1.5 mg/l, from bottom samples collected at Reno Narrows and near the Lahontan Dam in May 1976.

TDS ranged from 183 mg/l (June 1967) to 108 mg/l (October 1975) from 1966-1976. Compared with Pyramid Lake, Lahontan Reservoir has about one-thirtieth the TDS concentration.

Expected Limnological Change for Early Start Project Conditions. Perhaps the most significant data presently available for projecting the future are estimates of changes in the amounts of algal-stimulating nutrients that may annually flow into the reservoir via the Truckee Canal. To complete a full nutrient budget large amounts of other nutrient data in terms of quantity and kinetics would have to be available. For example, there are two primary sources of nutrient input, the Carson River and the Truckee Canal. Some nitrogen may be added by nitrifying blue-green algae. The primary output is agricultural water release and overflow from the reservoir. Moreover, some nitrogen is removed with plants and animals taken from the reservoir, bacterial denitrification and percolation to the groundwater, while nutrients are also stored indefinitely in bottom sediments.

Data useful to a nutrient budget analysis are available, and the USGS in cooperation with the state is engaged in studies to make quantitative ecological predictions for the reservoir, but this information will not be available in the near term.

Based on available data and information relative to the Master Project, total nitrogen loading to the reservoir from the Truckee Canal may increase from the estimated present 1,948 pounds per day to 2,183 pounds per day with full implementation of the JWPCP 30 mgd ESP. This estimate is based on a continued use of the 406,000 AFY operating criteria for TCID. Under the 288,000 AFY criteria the nitrogen load with the 30 mgd ESP may decrease from the present 1,948 to 710 pounds per day. The decrease results from the load associated with the 118,000 AFY decrease in water inflow from the Truckee River. In the total nitrogen load that does occur about 62 percent would originate from the 30 mgd JWPCP which contrasts with the present 48 percent of the total annual load. The annual total nitrogen load per square meter from the Truckee Canal to the reservoir presently amounts to about 6.32 grams/m^2/yr.

The total phosphorus load will decrease with ESP phosphorus removal from the present 468 pounds per day to either 19 or 60 pounds per day depending on the TCID operating criteria. This places a potential incremental annual load decrease from the present 1.80 grams/m^2/yr to the 30 mgd ESP of .73 grams/m^2/yr.

The annual load of other potential pollutants entering the reservoir also varies with the proportional amount of Truckee River water diverted to the canal. Data are not available to estimate whether some of any of these other potential pollutants, e.g., total dissolved solids, zinc, refractive, organic materials, have a measurable adverse influence on the reservoir. Environmental studies done to date have concentrated on nitrogen and phosphorus and their potential to exacerbate the excessive growths of algae, blue-green algae in particular, and the lowering of concentrations of dissolved oxygen that impair the quality of beneficial uses derivable from the reservoir.

Affected Beneficial Uses. The affected environment and thus beneficial uses significantly involve aquatic habitat and fish, recreation, agricultural water supply and potential drinking water supply. Water quality standards were established by the NDEP in 1979 to protect these beneficial uses (Table 4-15).

The data presented previously summarize water quality and the general ecological condition of the reservoir. The nature of the beneficial uses and the identification of changes that may result from the no-project action follow.

Aquatic Habitat and Fish. Lahontan Reservoir provides the habitat to support the fourth to sixth ranked fishery in the State of Nevada (DOI, 1977 and NDW, 1980). The reservoir is classified as warmwater fish habitat although rainbow and brown trout reside in the lake and provide a seasonal fishery. There is no natural reproduction of trout. At issue are the effects of increased nutrient loading on the lake relative to impairment of the fish habitat through generating conditions that lower the concentrations of DO. Midsummer concentrations of DO in the deeper, cooler parts of the lake are now marginal for trout production and these levels will lower further as nutrients accumulate in the lake.

The native fish species in the reservoir include the tui-chub (Gila bicolor), Tahoe sucker (Catostomus tahoensis), Lahontan redside (Richardsonius egregius), speckled dace (Rhinichthys osculus), and the Lahontan sucker (Pantosteus lahontan). Nonnative species include the rainbow trout (Salmo *gairdneri*), brown trout (*S. trutta*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), white bass (*Morone chrysops*), white crappie (*Pomoxis annularis*), Sacramento perch (*Archoplites interruptus*), yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), white catfish (*Ictalurus catus*), channel catfish (*Ictalurus punctatus*), and bullhead (*I.* sp.). Nongame species include carp (*Cyprinus carpio*), Sacramento blackfish (*Orthodon microlepidotus*), and mosquitofish (*Gambusia affinis*).

The prospect of the continued discharge of large quantities of nitrogen and phosphorus into the reservoir and the resulting intensification of eutrophication may favor the production of some of the fishes, e.g., tui-chub, bullhead, blackfish and carp. Other than an educated guess it is not possible to estimate what actual changes in the fish community may occur.

Recreation. Fishing, boating, and water-contact sports are seasonally intensive on the lake, and generate economic and social benefits. In 1979 the reservoir sustained 77,237 angler days, and a total of 515,845 visitor days. Recreation could be impaired by water quality conditions that impair the fishery or water-contact sports. Algal growth resulting from nutrient loading, beyond an acceptable condition in this case, has the potential to impair the resources that attract recreationists to the lake.

Increasing densities of algae are known to be aesthetically displeasing in addition to causing the soiling of boats, water skiers, bathers and their gear. Windrows of decaying blue-green algae can spoil beach areas and cause noxious odors. Furthermore, decaying algae in situations that cause anaerobiasis can lead to botulism toxicity in waterfowl. Although the severity of these types of events are a matter of personal perspective, extreme eutrophication is typically viewed with alarm by the recreational community. Clear Lake, California and upper Klamath Lake, Oregon are guiding examples of the effects of extreme algal growth on recreational use.

The increase in nutrient loading associated with no-project action is expected to increase algal production; however, any quantitative estimate about the magnitude of increase must await the preparation and verification of a nutrient budget and algal growth model specific to Lahontan Reservoir.

Potential Drinking Water Supply. Lahontan Reservoir has been proposed as a municipal water supply for the Fallon, Nevada area. The disposal of treated wastewater indirectly to the reservoir, and in other situations with insufficient dilution and time for natural treatment purification to take place, would constitute a significant public health risk and aesthetic impact for this use. Surface waters discharging from Lahontan Reservoir play a long-term role in recharging the deep aquifers which presently are the municipal supply for the City of Fallon and the Fallon Naval Air Station.

Wastewater discharged from the Reno-Sparks JWPCP and mixed with varying proportions of river water presently flows into Lahontan Reservoir. Domestic, industrial, and agricultural wastes from other sources discharging to the Truckee and Carson Rivers also enter the reservoir. An indication of present conditions can be obtained from the Carson River Basin COG report (1978).

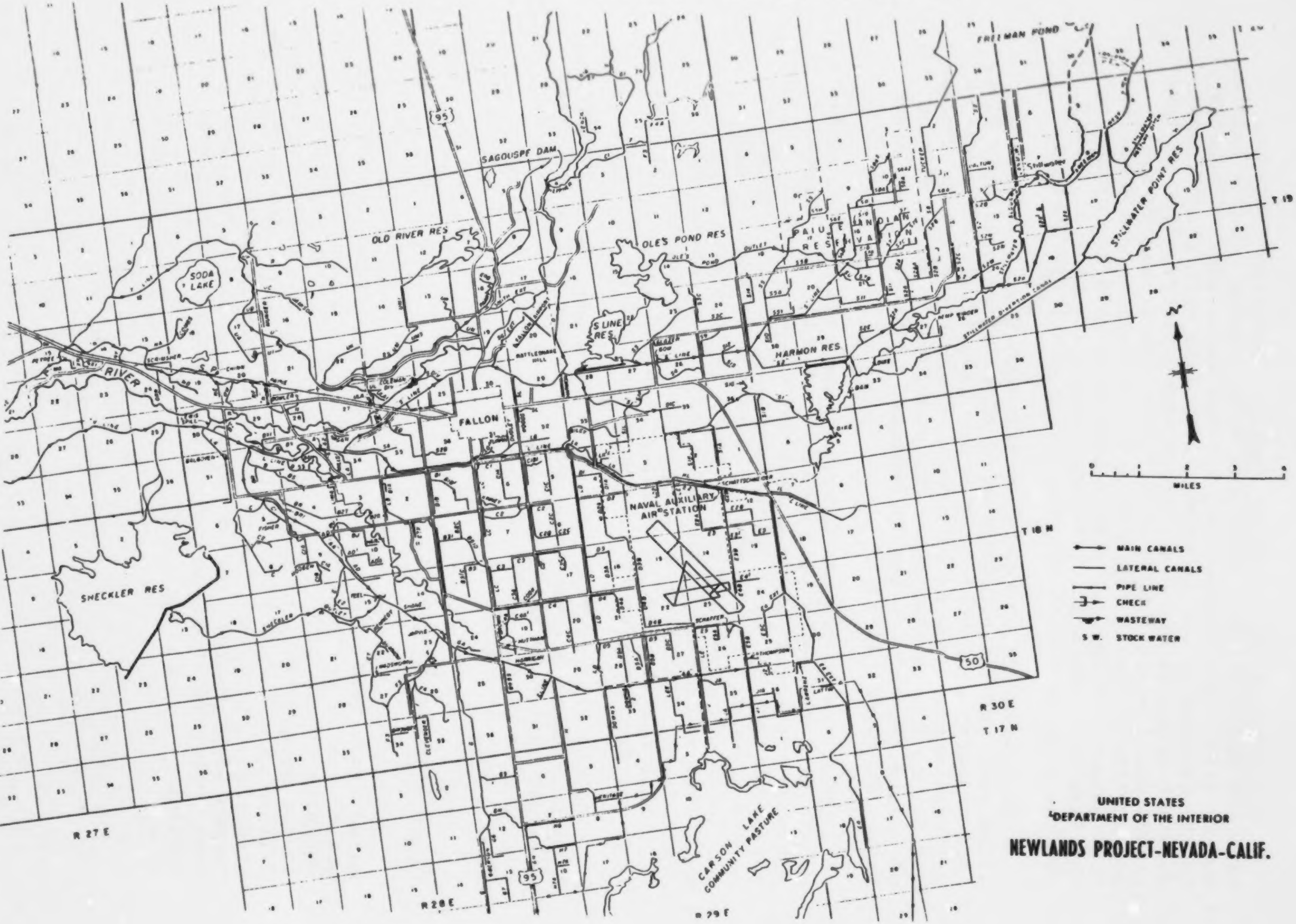
Under the no-project action treated and diluted wastewaters from the JWPCP will continue to enter the reservoir. Although treatment and chlorination remove or greatly reduce most pathogens and some toxic and carcinogenic chemicals before discharge to the river, additional treatment also occurs in the river and canal; there is some risk that pathogens and hazardous chemicals may reach the reservoir. There is no definitive data available to assess the level of public health risk. Certainly it would increase if treatment and disinfection failures occur at the JWPCP.

Use of the reservoir for domestic supply would probably require expensive water treatment to remove solids and taste and odor caused by the blue-green algae. An assessment of any risk to public health should be made before use as a drinking water supply.

Below Lahontan Reservoir

The Carson River below Lahontan Reservoir is distributed via a maze of canals and detention reservoirs for irrigation use in the Fallon area (Figure 4-29). From there water is either lost through evapotranspiration, percolated to the groundwater, or returned to the Carson River via return drains. The Carson River then flows to the Stillwater Wildlife Area where it is used for wildlife management purposes. The Carson River system finally terminates in the Carson Sink area, where water evaporates or percolates to groundwater aquifers.

Figure 4-29. Newlands Project - Nevada, California.



SOURCE: DOI, 1977.

Fish and Wildlife

Aquatic Habitat and Fish in the Truckee River

The populations of fish and fish food organisms inhabiting the Truckee River respond to conditions generally described in total as habitat. For purposes of description and analysis, the river can be segmented into several habitat types with each type being used by several species. The description of a habitat type can be based on factors covering a range of natural and project situations. The first segmentations used to describe habitat type are geographical and related to a large extent to features of water projects. They are the river segments from Verdi to above Steamboat Creek, Steamboat Creek to Vista, Vista to Derby Dam, Derby Dam to Wadsworth, and Wadsworth to Pyramid Lake (Figure 4-1). Water flow and quality in these reaches are greatly influenced by water diversion, agricultural return water, and the discharge from the Reno-Sparks JWPCP. Over the period of a year they all differ quite markedly in their physical, chemical and biological characterization.

Another habitat division relates to summer and winter water temperatures, e.g., the river between Verdi and Steamboat Creek is a year-round coldwater habitat type, while from Steamboat Creek to Derby Dam the river is typically a transition zone between coldwater and warmwater types. The river is a warmwater habitat type from Derby Dam to Pyramid Lake. However, during the winter, spring and early summer the entire river can be suitable habitat for coldwater fishes if river flow is sufficiently great.

Pools, riffles and cascades are characterized as habitat types as are the distinct entities, water column and bottom substrate. All of these can be subdivided further. Habitat type descriptors are also species specific, e.g., spawning sites, migratory routes, cover and food sources.

Water and wastewater projects may directly change habitat type characteristics which in turn influences, limits, or controls the use of a habitat type by a particular species.

Before the river was intensively developed for water diversion it provided habitat for at least eight native species of fish, all of which had free access to the river from Pyramid Lake to Lake Tahoe. Water diversion, water quality degradation and the introduction of exotic species have combined to extirpate the original strain of Lahontan cutthroat trout and endangered the cui-ui. The foremost problem for these species has been the diminishment of flow in the river downstream of Derby Dam and the lowering of Pyramid Lake which blocks the natural passage of fish between the river and lake. The Marble Bluff dam and fishway was constructed in 1975 to mitigate the blockage problem. Several subsidiary habitat alterations have resulted from the lowered flow and nutrient enrichment of the water, e.g., lower concentrations of dissolved oxygen, warmer water temperature, and enhanced habitat for nuisance species such as carp and green sunfish. Toxic conditions associated with the JWPCP effluent has caused fish kills downstream of Steamboat Creek (PEL, 1979). Water quality and habitat conditions are described in detail in the PEL (1979) report and summarized in the hydrology and water quality sections of this chapter.

The detail that can be used to describe habitat requirements for particular species varies greatly among the species (Appendix I). Species of trout are the most studied and hence most definable in terms of habitat requirements. The Lahontan cutthroat trout for example has been intensively studied in the Truckee River and Pyramid Lake (USFWS, 1979; Ringo, 1975; Powell, 1975; Wolcott, 1978; and Hansen, 1979). The literature for the cui-ui includes papers by Cope (1883), Snyder (1917), Johnson (1958), Koch (1973) (1976), Sonnevil (1978) and others. The conditions of particular aquatic habitats in the Truckee River have been described by several authors. A review of past studies plus original work done in 1977 and 1978 by PEL was recently compiled into a comprehensive report (1979). These studies were relied on for the analysis of the effects of the Reno-Sparks JWPCP on Truckee River habitats and fishes.

Issues and Impacts of the Early Start Project. The no-project condition of implementing the 30 mgd ESP will mitigate some of the major adverse effects. Toxicity attributable to chlorine will be avoided by dechlorination. Pursuant to grant conditions on the ESP, water will be available to dilute some low flow-related toxic conditions. Advance treatment to remove phosphorus will be implemented to reduce periphyton growth, by causing the habitat to become phosphorus limited. This limitation on algal growth is expected to decrease the adverse effects of low concentrations of dissolved oxygen in the water and bottom sediments. The current discharge concentrations of BOD, nitrite, nitrate and other unidentified potential pollutants will continue.

Under no-project conditions toxicity levels in the zone of mixing should be greatly reduced and the habitat should improve, allowing regular use by sport fish and other organisms now excluded from the zone. Downstream habitat improvement depends on the effectiveness of phosphorus removal in reducing periphyton growth and associated DO problems. Nitrite and nitrate toxicity is expected to increase as the load of these toxicants increases with the magnitude of discharge from 20-30 mgd.

Habitat types and issues in the existing system may be categorized and described by reach, as summarized below:

Farad to Above Steamboat Creek. This reach is a coldwater habitat supporting trout, whitefish, and sculpin, composed of more riffles than pools with a gravel and rubble substrate. Major problems for fish in this reach are associated with the construction and operation of water diversion facilities (Ringo, 1975), which impede passage, divert fish into irrigation systems and result in lower instream flow and thus habitat. This reach is also influenced by nutrients and potential pollutants discharged to the river during storm events, accidents, and agricultural drainage. Although altered by the development of regional land use and water resources the habitat on biological resources in this reach appears to support the beneficial uses attributed to it. Low instream flow and coincident warmwater temperatures that exceed 13°C before June 1 and 21°C during the summer; an inflow of nutrients, potential toxicants, sediments and debris with urban stormwater drainage; and loss of natural riparian habitat represent major concerns about the fishery.

There are no direct impacts on this reach associated with the JWPCP. Increased diversions of water as the area converts from agricultural to urban land uses are not expected. Increased urban-type runoff compared to a decrease in agricultural return-type water is expected as secondary impacts of population growth. The Washoe Council of Governments 208 program established nonpoint source control plans which are in the process of implementation. The secondary effects of growth on water quality along with riparian land use changes have not been defined.

Whether a Master Project is implemented or not, it can be concluded by interpreting data in the hydrology and water quality sections, coupled with growth projections, that this reach of river will not improve but in all likelihood will degrade over the long range unless resource management programs are fully implemented to maintain and protect the habitat. Fish and recreational use of the reach is expected to continue as in the past.

Steamboat Creek to Derby Dam. During most months of most years this reach is classifiable as a coldwater habitat; however, during peak warm periods and dry years when river flow is lower than normal, the water temperature exceeds that considered tolerable by coldwater species, i.e., 13°C for spawning and egg incubation and 21-25°C at other times. The slope in this reach is less than for other reaches, causing it to have a greater pool-to-riffle ratio and finer particle sizes in the sediment. The habitat is more suitable for warmwater species, e.g., largemouth bass, crappie, and channel catfish than the upstream reach. Native transitional zone fishes, i.e., suckers and Lahontan redside, are also more abundant in this reach.

The habitat in this reach has been greatly altered by the discharge of sewage effluent from the JWPCP, agricultural drainage, flow regulation, diversion of water into irrigation systems, other water diversions, municipal stormwater runoff and riparian land use. Water and bottom substrate quality are features greatly affected by the JWPCP.

The effects of wastewater discharge were described by the PEL (1979) which reviewed and assembled data from past studies in addition to their own original work, and the no-project conditions are summarized in the hydrology and water quality sections of this chapter. Effluent from the JWPCP impaired the habitat by increasing the concentrations of chlorine, ammonia, nitrite, and nitrate to levels toxic to fish and fish food organisms. These alterations occurred for several miles downstream of the discharge. Nutrients added to the river stimulate the growths of algae, macroinvertebrates and fish in downstream areas. Dissolved oxygen is lower than desired and may be limiting certain bottom-dwelling species. The concentrations of other chemical substances were increased by the discharge with no reported effects on the biota. Heavy metals occur in relatively high concentrations and may accumulate in fish tissues to the detriment of some fish but no data relative to these potential effects are available.

Agricultural drainage, principally from the Steamboat Creek and north Truckee drain, adds significant nutrients and salts to the river. The inflow of heat from the JWPCP and these sources may elevate river temperature especially during periods of low flow. These drains in combination with the JWPCP discharge increase the enrichment of the downstream area to a level considered detrimental to trout.

The water quality and nature of the habitat is described in greater detail in the water quality section under the Steamboat Creek to Vista and Vista to Derby Dam subheadings.

Perhaps most important to the welfare of fish in this reach is the mixing and dispersion zone from Steamboat Creek to about 5 miles downstream. This is an area where Steamboat Creek, the JWPCP discharge, north Truckee drain and the river join together. Toxic conditions kill fish and aquatic organisms in this area and typically impaired and degraded the area for most beneficial uses. In addition to prohibiting game fish from living in the area, it probably forms a barrier to fish migration during certain low river flows. The principal features of the barrier are toxicity, high temperature and depressed DO.

Flow regulation to meet water appropriation demands influences the effects of discharges from the JWPCP and the agricultural drains. During periods of water conveyance to the Truckee Canal diversion, wastes are diluted and transported more quickly through the system, probably lessening any adverse effect on the habitat. Flows regulated to lower than natural levels, on the other hand, increase the risk for adverse impact from waste discharge and by interfering with the inherent behavioral expectations of fishes.

Storm runoff from urbanized areas and traffic corridors seasonally places additional pollutant loading in this reach of the river. The effects of this loading have not been fully evaluated, although estimates of loading were made by the WCOG. This waste load melds with the JWPCP discharge and agricultural return water to produce the downstream conditions described in the PEL (1979) report. However, the JWPCP discharge is the major influencing factor.

A major correctable problem is the discharge of toxicants from the JWPCP, especially chlorine, nitrate, nitrite, and ammonia. Added to toxicity are other effects, e.g., excessive biological growth on bottom sediments. Heat loading from Steamboat Creek and north Truckee drain are also perturbations. These events may cause seasonal barriers to fish migrations as well as cause mortality in the zones of effect. The introduction of exotic fish that are effective competitors and predators, e.g., largemouth bass, black crappie, and channel catfish, coupled with enrichment and warmer water, which also favors these fish over native species, has probably impaired the quality of the habitat for both rainbow and brown trout as well as other native species.

Brown trout appear to tolerate conditions in this reach of the river in most years. Rainbow trout occurring in this reach are thought to be hatchery-reared fish. The NDW wishes to maintain this reach as a coldwater fishery, which it now does on a seasonal and water year basis. Recreational fishing has declined since the 1960s due to the degradation of the habitat and the resultant poorer fishing.

In summary, the principal issues for fish and other aquatic animals attributable to the JWPCP are:

1. The effluent discharged by the JWPCP includes toxic substances that cause toxic concentrations in the river, both acute and chronic. PEL (1979) studies indicate that the JWPCP has caused toxic concentrations of chlorine, ammonia, nitrate and nitrite to occur in the river.

2. Other potentially toxic substances are discharged from the JWPCP, e.g., zinc, and may at times be toxic to sensitive organisms.

3. Nitrate may be toxic to the development and hatching of trout eggs, and nitrate discharged by the JWPCP, or secondarily generated by the oxidation of ammonia discharged to the river, occurs in possibly toxic concentrations.

4. The discharge of biodegradable substances and ammonia causes a depletion of dissolved oxygen in the vicinity of the discharge, degrading that part of the river to a condition not supporting assigned beneficial uses.

5. Intensive enrichment of the river has produced relatively high standing crops of algae, periphyton, and invertebrate organisms which at night reduced DO to levels below 5 mg/l.

6. During periods of the year when river temperature is limiting or controlling for coldwater species, the JWPCP effluent adds heat to the river.

7. Effluent from the JWPCP degrades the habitat between point of discharge and Derby Dam to a condition that prevents its use by the threatened Lahontan cutthroat trout.

Fishes in the Truckee River. Fishes in the Truckee River system from Verdi to Pyramid Lake consist of both native and introduced game and nongame species. The principal game fishes found in the system include brown trout, Lahontan cutthroat trout, rainbow trout, mountain whitefish, largemouth bass, black crappie, and channel catfish. The Lahontan cutthroat trout and mountain whitefish are the only native game fishes. Native nongame species include the cui-ui, tui chub, Lahontan redside, speckled dace, Tahoe sucker, Lahontan mountain sucker, and Paiute sculpin. The endangered cui-ui uses the lower end of the river during years of high discharge to Pyramid Lake.

The USFWS (1979) recently determined the relative abundance and distribution of fishes in the Truckee River (Table 4-30). At least 13 species inhabit the river reach from the Verdi power diversion to Steamboat Creek. Mountain whitefish were most abundant followed by Tahoe suckers, mountain suckers, brown trout, Lahontan redside, and rainbow trout. Within this same reach Tahoe suckers had the greatest biomass, followed by mountain suckers, mountain whitefish, brown trout, and rainbow trout (Table 4-30). Paiute sculpins were commonly found in association with salmonids; however, the sampling technique employed (electro-shocking) produced inadequate sampling results for quantitative comparisons.

Downstream from the largest population of salmonids and sculpins, where the size and abundance of pools increase and slower water predominates, the Tahoe sucker, mountain sucker, Lahontan redside, carp and green sunfish become increasingly abundant. The largest number of species and biomass occurred from Steamboat Creek to Derby Dam. The Tahoe sucker was dominant, both in abundance and biomass. Other dominant species included the mountain sucker, Lahontan redside, carp and green sunfish. A 16-fold increase in carp

Table 4-30

RELATIVE ABUNDANCE/BIOMASS (kg) OF FISHES SAMPLED FROM VERDI POWER DIVERSION TO PYRAMID LAKE

Species[1]	Verdi to Steamboat Creek	Steamboat Creek to Derby Dam	Derby Dam to Pyramid Lake[1]	Total
Brown trout	20,653/2,423.7	657/279.2	24/18.1	21,334/2,721
* Lahontan cutthroat trout	248/14.8	123/19.3	-	371/34.1
Rainbow trout	6,250/671.1	616/115.3	-	6,866/786.4
* Mountain whitefish	61,399/2,809	378/55.1	63/0.4	161,840/2,864.5
* Tahoe sucker	95,152/13,470	225,603/18,292.2	143,085/14,380.4	763,840/46,142.6
* Mountain sucker	50,741/2,864.6	78,112/2,228	563,345/6,824.1	692,198/11,916.7
Largemouth bass	608/7.9	322/13.3	444/7.2	1,374/23.4
Green sunfish	244/4.3	1,869/37.4	1,192/39.2	3,305/80.9
Black crappie	37/0.04	99/1.3	28/8.2	164/9.5
Sacramento perch	one specimen taken			
Channel catfish	-	238/1.2	-	238/1.2
Brown bullhead	-	523/47.7	14/1.4	537/49.1
Carp	433/525.6	32,655/8,651.7	150,386/14,307	183,474/23,434.3
* Lahontan redside	10,349/139.1	39,457/253.9	569,242/3,124	619,548/3,517
* Speckled dace	261/0.9	135/0.7	31,750/47.8	32,196/49.4
Goldfish	-	681/55.2	-	681/55.2
Golden shiner	one specimen taken			
* Paiute sculpin	abundant	common	-	-
Mosquitofish	-	abundant	common	-
Total	346,875/22,931	381,519/30,051.5	1,759,573/38,757.3	2,487,966/91,740.3

[1] Cui-ui were not found during this survey.
* Native species.

SOURCE: USFWS, 1979.

biomass occurred in this stretch of the river over that from Verdi Division to Steamboat Creek. Mountain sucker biomass was third in importance. This reach of the river is most directly affected by the existing JWPCP discharge. Although it contains a lesser quantity of trout than upstream reaches, it supports a recreational fishery for trout as well as bass, crappie, and catfish.

Twelve fish species were sampled in the lowest reach of the stream from Derby Dam to Pyramid Lake. Although the number of species was least in this section of the river, overall abundance was highest (Table 4-30). The most abundant fishes included the Lahontan redside, mountain sucker, Tahoe sucker, carp, speckled dace, and green sunfish. The dominant species in terms of biomass were Tahoe suckers, carp, mountain suckers, and Lahontan redsides. Cui-ui were not sampled.

Specific habitat requirements for fishes in the Truckee River system have been described by Snyder (1917), Moyle (1976), LaRivers (1962), Koch (1972), and Johnson (1958). The Lahontan cutthroat trout as well as other salmonids (mountain whitefish, rainbow and brown trout), suckers (Tahoe sucker and mountain sucker) and redsides inhabit the colder reaches of the Truckee River.

Table 4-31 lists the distribution, food preferences, habitat requirements and spawning needs of fishes occurring from Verdi to Pyramid Lake. Appendix I contains life history and habitat requirement discussions for each of the fish species found in the Truckee River system.

The generic impacts of the existing and no-project conditions are summarized in the previous section and are given in detail in PEL (1979).

Threatened and Endangered Fish and Wildlife Species

The Endangered Species Act of 1973 provides a means by which endangered and threatened species may be conserved. Section 7 of the act requires federal agencies to consult with the USFWS regarding actions they authorize, fund or carry out that could affect the survival of an endangered or threatened species. The federal list of endangered and threatened species indicates that the endangered peregrine falcon (Falco peregrinus anatum), southern bald eagle (Haliaeetus leucocephalus leucocephalus), and cui-ui lake-sucker (Chasmistes cujus) and the threatened Lahontan cutthroat trout (Salmo clarki henshawi) are found within the project area. The peregrine falcon has been observed in the Truckee Canyon area (Linsdale, 1936), however, its distribution is largely cosmopolitan. The peregrine falcon commonly nests on cliffs and feeds primarily on passerine

Table 4-31

FISHES OF THE LOWER TRUCKEE RIVER SYSTEM FROM VERDI TO PYRAMID LAKE

Species	Distribution[1]	Food Species	Habitat	Spawning Season	Spawning Substrate	N/I[3]
Mountain whitefish	Verdi to Derby	Benthic invertebrates, zooplankton, surface insects	Streams with large pools	Oc-early De	Loose gravel	N
Rainbow trout	Verdi to Derby	Drift organisms, active benthic invertebrates	Clean, cool, fast-flowing, permanent streams and rivers, cold, deep waters of lakes	Fe-Jun (Jul-Au)	Gravel riffle	I
Lahontan cutthroat trout	Verdi to Pyramid Lake	Drift organisms, fishes	Variety of cool waters from small to large mountain lakes, major rivers to small tributaries	Ap-Jul	Gravel riffle	N
Brown trout	Verdi to River Mouth	Drift organisms, benthic invertebrates, fishes	Medium to large, slightly alkaline, clear streams with swift riffles and large, deep pools	No-De	Gravel Riffle	I
Tui chub	Pyramid Lake[2]	Invertebrates, aquatic plants	Weedy, rocky shallows of lakes or the quiet waters of sluggish rivers	late Ap-late Jun	Sandy bottom	N
Lahontan redside	Verdi to Pyramid Lake	Invertebrates, Tahoe sucker eggs	Lower courses of rivers in deep, quiet water, slow riffles, quiet, shallow pools	late Ma-Au	Sand and gravel areas of pools	N
Speckled dace	Verdi to Pyramid Lake	Benthic invertebrates, crustaceans	Cool, flowing rocky-bottom permanent streams and rivers, large lakes on rocky or sandy bottoms	Jun-Jul	Gravel edge of riffles	N
Golden shiner	Reno to River Mouth?	Zooplankton, flying insects	Warm ponds, lakes and sloughs associated with dense mats of aquatic vegetation	Ma-Au	Submerged vegetation and bottom debris	I
Goldfish	Reno to Derby Dam	Phytoplankton, zooplankton organic detritus, aquatic macrophytes	Fertile ponds and sloughs with heavy growths of aquatic vegetation	Ap-Ma	Aquatic vegetation, flooded grass, roots, leaves	I
Carp	Reno to Pyramid Lake	Plankton, benthic invertebrates	Warm, turbid water, generally associated with eutrophic waters with silty bottoms	Spring-early Summer	Weedy areas	I
Tahoe sucker	Verdi to Pyramid Lake	Algae, benthic invertebrates	Moderate depths in large lakes, shallow water in tributary streams	Ap - early Jun	Rock and gravel	N
Cui-ui	Pyramid Lake	Zooplankton	Pyramid Lake and lower Truckee River during spring spawning runs	Ap-early Jul	Bar or gravel bed	N
Mountain sucker	Verdi to River Mouth	Algae, invertebrates	Pools behind submerged rocks or logs in swift water	Late Jun-mid Jul May-mid Aug?	Gravel riffle	N
Brown bullhead	Reno to River Mouth	Aquatic insects, crustaceans, molluscs	Ponds, small lakes, river backwater, small stream pools with warm, turbid water, muddy bottom, slow current	Jun-Jul	Moderate to heavy submerged vegetation	I
Channel catfish	Reno to Derby Dam	Invertebrates, fishes	Clear, rapidly flowing, warm-water streams with sand, gravel or rubble bottoms	Ap-Jun	Muskrat burrows undercut banks, log jams	I
Mosquitofish	Reno to Pyramid Lake	Mosquito larvae and pupae, algae, zooplankton, fishes, terrestrial insects, aquatic invertebrates	In brackish sloughs, shallow stagnant ponds and the shallow edges of lakes and streams	Ap-Se	Nonspecific	I
Sacramento perch	Reno to Pyramid Lake	Crustaceans, aquatic insects, fishes	Sloughs, sluggish rivers, lakes	mid Jun-early Au	Heavy growth of aquatic macrophytes or filamentous algae	I

Table 4-31. Cont'd.

Species	Distribution[1]	Food Species	Habitat	Spawning Season	Spawning Substrate	N/I[3]
Green sunfish	Verdi to River Mouth	Invertebrates, small fishes	Small, warm streams, ponds and lake edges	Ma-Au	Fine gravel	I
Black crappie	Reno to River Mouth	Zooplankton, aquatic insects, fishes	Large, warm, clear lakes and reservoirs with large beds of aquatic plants	Ma-Ap	Mud to gravel	I
Largemouth bass	Reno to River Mouth	Invertebrates, fishes	Farm ponds, lakes, reservoirs, sloughs and river backwater with aquatic plants	Ap	Sand, gravel, or debris-littered bottoms	I
Paiute sculpin	Reno up Derby Dam	Benthic invertebrates, insect larvae, other sculpins	Aquatic weed beds in deep water lakes, rocky riffle sections of clear, cold mountain streams	Ma-Jun	Under rocks	N

[1] Known or expected distribution.
[2] Present occurrence undetermined.
[3] N/I = Native/Introduced

SOURCES: Environmental Protection Agency, 1977; Moyle, 1976; LaRivers, 1962; and Scott and Crossman, 1973.

birds, waterfowl, and shorebirds. The southern bald eagle is known to winter throughout the area, and is primarily associated with lake and stream environments. Fish constitute the principal diet item. Among the endangered and threatened species in the project area, the cui-ui and Lahontan cutthroat trout occupy habitat that could be affected by the Reno-Sparks JWPCP and, thus, constitute an issue for that project. Consequently, the following evaluations and discussions focus on these species.

Lahontan Cutthroat Trout, *Salmo clarki henshawi*. Lahontan cutthroat trout historically occurred throught the Lahontan Basin. The native Pyramid Lake population is now extinct. The existing Truckee River Lahontan cutthroat trout was introduced and is maintained through artificial propagation and stocking. Due to the success of the hatchery program and other stocking and management programs, the Lahontan cutthroat trout, originally listed as endangered on October 13, 1970, was reclassified to threatened status on July 16, 1975.

The construction of Derby Dam in 1905 and subsequent transbasin diversion of water for agricultural use in the Carson River Basin led to the decline and eventual extinction of the native Pyramid Lake cutthroat trout population. By 1939, there were 14 other diversions between Derby Dam and Nixon which contributed to lower flows, higher water temperatures, and lower dissolved oxygen concentrations (PEL, 1979a). In addition, unscreened diversions turn many fish, especially juvenile fish, into canals and ditches where they die. Occasionally, the entire flow of the Truckee River had been either diverted or noticeably polluted. Waste from a paper mill at Floriston was regularly dumped into the river. As early as 1913, experimental hatchery studies showed this practice to be lethal to fishes. Sawdust was also being dumped into the river from nearby sawmills in the 1930s. A series of low water years which occurred during this time prevented the sawdust from being flushed from the river. Until about 1930, untreated sewage from the Cities of Reno and Sparks was also discharged to the river. This practice ended when the first sewage treatment plant was constructed. The combined effects of the transbasin diversion, unscreened diversion, and the degradation of the quality of water in the river were ultimately responsible for the demise of the Lahontan cutthroat trout population in the Truckee River. The last known spawning run occurred in 1938; however, instream flow and probably the quality of water was insufficient for reproductive success and the wild, naturally reproducing population became extinct. Lahontan cutthroat trout were subsequently reintroduced to Pyramid Lake and are maintained through fish hatchery operations.

Lahontan cutthroat trout inhabit a variety of aquatic habitats including large alkaline lakes, small mountain lakes, major rivers and small tributaries (Moyle, 1976). Thus, it is assumed that their habitat requirements are broadly based and representative of trout in general. In the absence of barriers, spawning cutthroat trout historically would leave Pyramid Lake beginning about the middle of February and generally spawn from April to early July. A study by Hansen (1979) to determine the effects of physical factors in the Truckee River on the spawning success of cutthroat trout indicates that the distribution of eggs in the river is dependent on the availability of suitable spawning grounds in the river. Once a suitable spawning site is located, the fertilized eggs are placed in the redd (nest) and covered by about 6 inches of gravel. The young hatch and emerge from the ground in about 6-8 weeks (McAfee, 1966).

Lahontan cutthroat trout feed primarily on invertebrates while juveniles but become piscivorous as they increase in size. Growth rate varies, depending on water temperature, abundance of food, and other factors.

In order to assess the feasibility of reestablishing naturally reproducing populations of Lahontan cutthroat trout the individual and related effects of temperature and flow and the concentrations of chemical constituents found in the Truckee River must be thoroughly evaluated in relation to habitat requirements.

The formation of the Delta at the mouth of the Truckee River was a critical event because it impeded the upstream movement of Lahontan cutthroat trout to spawning and rearing habitat. Trout require highly oxygenated, cold water and a gravel substrate in which to construct redds to deposit their eggs. The potential reinstatement of the cutthroat trout run to the Truckee River was made possible in 1975 by the construction of the Marble Bluff Dam and Pyramid Lake Fishway. Lahontan cutthroat trout spawning runs ascend the fishway to the fish handling facility at Marble Bluff (Wolcott, 1978).

The Lahontan cutthroat trout is typical of coldwater species that require an environment in which temperature regimes do not exceed critical tolerance limits for spawning, egg incubation, and fry and fingerling development. Stream temperatures in the Truckee River are primarily dependent on instream flow. On-going temperature and water quality studies of the river below Derby Dam show that critical conditions to which trout are sensitive are often exceeded in this stretch of the river (USFWS, 1979).

Flows in the Truckee River below Derby Dam have declined considerably since the initial construction of Derby Dam and subsequent inclusion of over 30 other diversion structures. The combination of the lower flows, warmer temperatures, poor water quality, and the actual presence of the dams eventually led to the demise of the adult spawning population. Present efforts to reestablish the cutthroat trout in the river have focused on eliminating barriers, abatement of pollution, and establishing flow and temperature requirements necessary for survival throughout the life stages of the cutthroat trout. A detailed discussion of Lahontan cutthroat trout habitat relationships is in Appendix I.

Cui-ui Lakesucker, *Chasmistes cujus*. The cui-ui is an endangered lacustrine sucker which primarily inhabits the offshore waters of Pyramid Lake but congregates at the mouth of the Truckee River during the spring to spawn. The cui-ui was originally listed as endangered in the *Federal Register* on March 11, 1967. Critical habitat for cui-ui has not been determined, although a recovery plan has been prepared for this species (FWS, 1977).

The Pyramid Lake cui-ui population has been on the decline since the construction of Derby Dam and the establishment of the Newlands Reclamation Project in 1905. Since the inception of the many other diversion projects on the river the level of Pyramid Lake has declined and subsequently formed a silt delta across the mouth of the Truckee River, virtually eliminating the upstream spawning migration of cui-ui. Marble Bluff fishway was installed in 1975 to allow upstream migratory fish to circumvent this barrier.

The cui-ui (*Chasmistes cujus*) is an indigenous lacustrine sucker found only in Pyramid Lake, Nevada. Relict populations of the genus (*Chasmistes*) occur in Klamath Lake (*C. brevirostris*) and Utah Lake (*C. liorus*).

Generally, cui-ui are observed only during the spawning season. At other times, they are believed to inhabit the deeper waters of Pyramid Lake. Spawning normally would take place in shallow waters in the lower Truckee River beginning during the middle of March and peaking in mid May. Historically, cui-ui annually ascended the Truckee River to spawn but in recent years significant migrations have been limited to wet years.

Stomach analyses conducted by Johnson show zooplankters as the main food item in the cui-ui diet. Stomach analyses performed by Koch (1976) indicated a preference for *Miona* in the earlier feeding stages of cui-ui.

The loss of spawning access to the Truckee River spearheaded a number of measures to restore the cui-ui fishery. Initial studies entailed the compilation of baseline data such as age and growth, population estimates and sex composition. Subsequent studies concentrated on the development of artificial propagation techniques, stocking programs, barrier removal and population monitoring (Appendix I). Monitoring of the cui-ui spawning population has occurred since 1971 (Sonnevil, 1977). In 1975, USFWS started an ongoing program to restore the endangered cui-ui through implementation of the *Cui-ui Recovery Plan*. The draft plan was completed in 1978 and critical habitat information contained in the plan is presently awaiting publication in the *Federal Register*. For additional detail see Appendix I.

The impact of existing and no-action conditions is summarized in the previous section on *Aquatic Habitat*. A detailed description of existing water quality problems is given in PEL (1979). A full discussion of the problems and plans for recovery of the cui-ui and Lahontan cutthroat trout is available in two USFWS reports: *Cui-ui Recovery Plan*, December 1977; and *Restoration of a Reproductive Population of Lahontan Cutthroat Trout to the Truckee River/Pyramid Lake System*, 1979.

Terrestrial Habitat and Wildlife

Wildlife habitats that may be affected by the Reno-Sparks JWPCP are generally located along the Truckee River, at terminal lakes, or off river disposal areas. There is principal concern about wildlife habitats in areas managed by the USFWS. Other areas of concern for wildlife are Dodge Flat, the riparian corridor along the river and areas converted from agriculture and open space by urbanization. These areas are described in summary, and conclusions are made about existing conditions and impacts of no-action (ESP conditions).

Anaho Island National Wildlife Refuge. Anaho Island, a bird rookery, lies in Pyramid Lake and entirely within the Pyramid Lake Indian Reservation. It can be affected by inflow to the lake and by changes in lake ecology that alter food supplies for fish and insect eating birds. Food sources could be altered by excessive eutrophication. The island is about 1 mile wide and .50 mile long and presently covers nearly 750 acres. Its summit, which is about 600 feet above the lake surface, is at 4,377 feet in elevation. The volcanic rocks of the island are overlain with the calcareous deposits called tufa, characteristic of Pyramid Lake, which formed when the island was under the waters of the ancient Lake Lahontan. The more important plant species found on the island include shad scale, greasewood, winterfat, and fourwing saltbush (Woodbury, 1966).

The fauna of the island is unique and is of considerable biological interest. Anaho Island supports the largest and one of the few nesting colonies of white pelicans in North American, supporting a total population of as high as 16,000 in 1953. The white pelican is piscivorous, feeding primarily on tui chubs and carp in Pyramid Lake and the shallow marshlands of the Stillwater Wildlife Management Area (75 miles southeast), Lahontan Reservoir (50 miles south), Walker Lake (90 miles south), and Washoe Lake (50 miles southwest).

It appears that the total regional population of white pelicans and production of young, while fluctuating from year to year, has declined since the island was established as a national wildlife refuge in 1913. This decrease id probably due to human disturbance (boating, fishing, aircraft) during the nesting season from both authorized and unauthorized persons (Woodbury, 1966). Other factors, such as the availability of food and predation, also probably affected their decline, but the extent of these factors has not been documented. The California gull and the double-crested cormorant also appear to be declining due to human disturbance. Great blue heron and Caspian tern also nest on Anaho Island.

An additional concern and one possible affected by the Master Project is the potential exposure of a land bridge between the mainland and the island that can result from declining lake levels. Exposure of this land bridge could provide access to the island for humans and wildlife, potentially destroying the successful production of young birds, as has already occurred at Mono Lake, California. Upstream diversion and other water uses of Truckee River water have reduced inflow to Pyramid Lake by about one-half, leading to a lowering in lake level (approximately 70-75 feet since 1906) over what would be expected due to natural climatic fluctuation alone. This has allowed the island's land area to increase from 250 acres in 1913 to the present 750 acres. In 1966, Anaho Island was about .25 mile from the mainland with a separating maximum depth of 20 feet. Unless lowering of the lake level is stopped the land bridge will be exposed.

Any decrease in the amount of water flowing to the lake exacerbates the problem of maintaining the elevation of the lake thus increasing the probability of exposing the possible land bridge connecting the island to the mainland. The existing JWPCP and the 30 mgd ESP are not projected to alter inflow

Even with no-project action the secondary effects of growth and associated water consumption could affect the opportunities to maintain lake elevations over the long-term, i.e., beyond 20 years. Using the scenario analyses calculations during the next 20+ years, growth could consume enough water to lower river flow past Vista by as much as 3 percent or perhaps increase flow over the present if water use is more strictly regulated through conservation practices. It is assumed that the secondary effect of growth-related water consumption on Pyramid Lake water elevation will be minimal.

Another secondary impact relatable to long-term events is increasing salinity in Pyramid Lake. The salt load entering the lake is increased by human occupation of the watershed. A percentage of this salt originates in the sewerage system. At some point in time, that is presently undetermined, salinity in the lake may raise to levels that limit the production of tui chubs and other native aquatic organisms. Reductions in these aquatic populations could reduce the viability of Anaho Island as a nesting and rearing area for the fish-eating birds and also birds and other animals that prey on the nesting birds or scavenge the dead birds. Increased salinity in other surrounding wetlands could also affect those fish populations and reduce available food supplies. A long range forecast of salt loading has not been made, principally because effects in the next 20+ years are probably not measurable.

Large increases in algal growth due to long-term nitrogen loading may alter invertebrate and fish communities to the extent that some waterfowl species are adversely affected. The no-project action increases total nitrogen loading from the existing 3,781 lbs/day to possibly 5,593 lbs/day.

Stillwater Wildlife Management Area Habitat. The Stillwater Wildlife Management Area (WMA) is located in western Nevada about 18 miles northeast of Fallon. The Stillwater marshes are a remnant of the Pleistocene Lake Lahontan. The WMA presently encompasses almost 180,000 acres, including over 50,000 acres of private inholdings. In addition, about 24,000 acres of the total 180,000 acres have been set aside as the Stillwater National Wildlife Refuge. Sixteen primary waterfowl units with a potential water acreage of over 22,000 acres and three pasture acres of 2,420 acres have been developed on th4 WMA.

All WMA lands are managed cooperatively with the NDW under a 1948 agreement with the TCID. The entire area is located on public lands withdrawn for the Newlands Reclamation Project.

The Stillwater Marsh area provides most of the wildlife recreational benefits. It includes approximately 22,000 acres of water area when the Pelican Island area receives sufficient water. The marsh depends mainly on agricultural return flows from irrigated lands and no water rights have been established for the WMA. Drain flows were generally adequate from 1948 up to the 1960-1961 drought. Since this time, flows have been marginal with only occasional years of good water receipts. The WMA can utilize an optimum 131,200 acre-feet of water per year, with approximately 91,400 acre-feet needed to maintain all water areas; the higher figure would provide for flushing of saline water. A minimum of 50,000 acre-feet of water may maintain a viable waterfowl area of much smaller acreage. Between 1972 and 1976 the net receipts have averaged 58,000 acre-feet (USFWS, 1977).

The Stillwater Marsh area has been an historic stop-over point for migratory waterfowl during their spring and fall migration, as well as an important nesting site for many waterfowl, marsh and shorebirds. Peak numbers of 250,000 ducks, 10,000 geese and 13,000 whistling swans occur during good water years. Under ideal nesting conditions, waterfowl produce up to 15,000 young. Cinnamon teal, gadwall, and redhead are the principal nesting species. Stillwater is unique in providing a fall migration stopover and feeding location for an average of over 30 percent of the winter Pacific Flyway population of canvasback with a high of 56 percent in 1970. Stillwater WMA is also an important redhead nesting area, producing about 3,500 redhead young per year under good marsh conditions (USFWS, 1977).

The Stillwater WMA is also an important recreational site in northwest Nevada which is described in more detail in the section on recreation. The no-project action does not appear to impact existing operations of the area.

Fernley Wildlife Management Area Habitat. The Fernley Wildlife Management Area (WMA) is located about 5 miles east of Fernley and encompasses 13,655 acres. The Fernley WMA has two primary ponds and two dikes (constructed in 1950) with a potential developed wetland area of 10,000 acres, although presently less than 1,000 acres are suitable for waterfowl habitat (Barngrover, pers. comm.). The primary water source for these wetlands is irrigation return flows through the Fernley drain. Although wetlands found in this area historically are drying, the numerous upstream diversions and increased consumption of Truckee River water have significantly accelerated this trend.

The Fernley WMA supports a wide variety and large population (when sufficient water is available) of waterfowl species. Green-winged teal, cinnamon teal, pintail, mallard, gadwall, shoveler and American widgeon are the principal species utilizing this area (NDW records). Cinnamon teal, redheads, gadwall, ruddy ducks, mallards and Canada geese are the principal breeding species at the Fernley WMA.

Although nesting waterfowl populations utilizing the Fernley WMA fluctuate from year to year, it appears there has been a decline in breeding pairs since 1970 (NDW records). Insufficient water supplies are probably the primary cause of this decline. The no-project action does not affect existing conditions on the area habitat.

Truckee River Corridor. The Truckee River provides adequate habitat for a variety of wildlife species. The cottonwood, willow, and northern desert shrub communities characterize much of the floodplain.

The area west of Reno along the lower Truckee River provides vital winter habitat for mule deer (Odocoileus hemionus), an important big game species. Evidence of mule deer occurring along the lower Truckee River was reported approximately 1 mile upstream from the Nixon USGS gaging station in 1974. This area is also the only mink (Mustela vison) habitat in Washoe County aside from Steamboat Creek (EPA, 1977).

Big game species such as black bear (Ursus americanus) and mountain lion (Felis concolor) are generally confined to mountainous areas outside of the area. However, mule deer ranges extend into the project area along the Truckee River west of Reno at locations where browse plants are readily available (EPA, 1977).

Other mammals reported to occur along the lower Truckee River include muskrat (Ondatra zibethicas), river otter (Lutra canadensis), badger (Taxidea taxus), long-tailed weasel (Mustela frenata) and ermine (Mustela erminea). Beaver (Castor canadensis) populations have increased in this area as a result of the lack of natural predators. Consequently, riparian vegetation of the lower Truckee River has been severely reduced due to overgrazing by beaver (EPA, 1977).

The Truckee River between Verdi and Reno provides habitat for several rare bird species (e.g., water ouzel, raptors) that overwinter but are not indigenous to the area. These populations rely on the adjacent fields for food and nesting. Although the water ouzel (Cinclus mexicanus) is not native to this area, it often overwinters along the lower Truckee River (EPA, 1977).

Avian species such as the great blue heron (*Ardea herodias*), the double-crested cormorant (*Phalacrocorax auritus*), and several species of duck including the common merganser (*Mergus merganser*) and the hooded merganser (*Lophodytes cucullatus*), coots (*Fulica americana*), and geese have been reported to occur along the lower Truckee River. Other waterbirds inhabiting this area include the pied-billed grebe (*Podilymbus podiceps*), the American bittern (*Botaurus lentiginosus*), and the California gull (*Larus californicus*). Small game birds such as the sage grouse (*Centrocercus urophasianus*), the ringnecked pheasant (*Phasianus colchicus*), the chukar partridge (*Alectoris chukar*), mourning dove (*Zenaidura macroura*), and California quail (*Lophortyx californicus*) are present along the lower Truckee River. The chukar partridge was introduced into Nevada in the 1940s and 1950s, and has adapted sufficiently to the new environment to become quite common in some areas. Unfortunately, habitat destruction resulting from urbanization has resulted in the decline of both sage grouse and pheasant populations (EPA, 1977).

Reptiles and amphibians (collectively termed herptiles) of the lower Truckee River have not been reported to be abundant, probably as a result of the limited amount of cover found in many areas along the river. Areas of relatively quiet water with abundant growths of aquatic vegetation and cattails provide habitat for the bullfrog (*Rana catesbeiana*) and the leopard frog (*Rana pipiens*), which were reported in the area in 1946 and in 1973 along the lower Truckee River drainages. Several species of snakes, including the garter snake (*Thamnophis* spp.), inhabit the lower Truckee River area. In places, habitat is available for a variety of reptilian species known to occur in the area. However, no surveys for those areas are available (EPA, 1977).

Urban Growth Areas. The few wildlife species which inhabit metropolitan areas include songbirds such as the robin (*Turdus migratorius*) and the house sparrow (*Passer domesticus*), the mourning dove, rats, mice, and ground squirrels (*Spermophilus* spp.). However, encroachments upon habitat as a result of urbanization and development have limited wildlife populations, particularly in the vicinity of Reno-Sparks. Habitat destruction often forces wildlife into higher elevations, making survival in the winter months difficult. Due to a channelization project along the lower Truckee River in the 1960s by the U. S. Army Corps of Engineers, the riparian vegetation of the river was severely reduced; since that time, overgrazing by both cattle and beaver has kept riparian plant growth at a minimum, especially between Wadsworth and Nixon, Nevada. Studies conducted on the lower Truckee River in 1974 indicated that riparian vegetation was extremely sparse except in a few areas where it has reestablished itself. A sampling location at Numana Dam was reported totally barren of riparian vegetation, leaving the river banks exposed over most of the area (EPA, 1977).

Dodge Flat. Wildlife species occurring in the Dodge Flat area are representative of those inhabiting arid sagebrush plain and riparian zones. Species which are found in the area are discussed in the biological resources section of the Dodge Flat narrative.

Groundwater Resources

Truckee Meadows

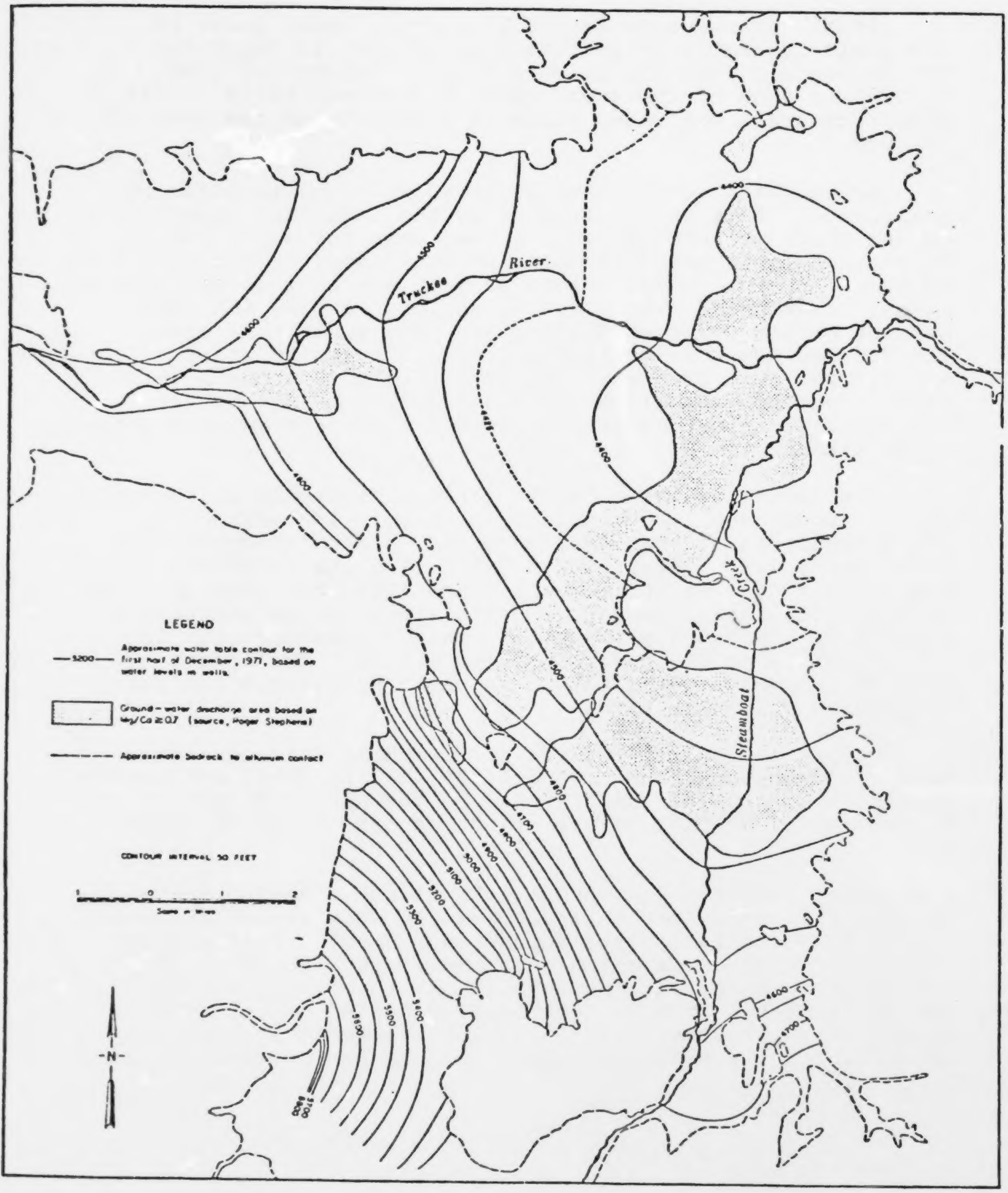
The Truckee Meadows groundwater basin consists of accumulated sedimentary deposits, or valley fill, underlying the general Reno-Sparks area to maximum depths exceeding 1,000 feet. Such sediments are pervious in part and yield water to wells over most of the area. Sediment thickness diminishes toward the perimeter mountain slopes.

The most productive aquifer material is found in the upper 300 feet or so of the valley fill inasmuch as deeper sediments tend to be finer-grained. A few of the larger wells range up to several thousand gallons per minute (gpm) capacity although most are much less productive. Many wells are used only for domestic and stock supply and pump less than 50 gpm. The largest groundwater extractor in the Truckee Meadows is the SPPCo which supplies the bulk of community water needs for the Reno area. The SPPCo total pumpage is presently running about 7,000 to 8,000 acre-feet per year. (SPPCo, 1979). Groundwater pumpage by others is roughly estimated at 3,000 to 4,000 acre-feet per year, making an area total of 10,000 to 12,000 overall. The increase in local pumping in the last 20 years has been dramatic, responding to population growth and commercial water needs of the area. Average annual well pumpage was reported by the USGS to have been 3,000 acre-feet for the period 1947-1959 (Cohen and Loeltz, 1964).

Principal recharge to Truckee Meadows groundwater is from seepage of waters distributed and applied for irrigation, and from percolation in stream channels. Groundwater is discharged from the basin through well pumping, groundwater discharge to the Truckee River and tributaries, and evapotranspiration from near-surface water tables (Figure 4-30). Generally, subsurface movement is from the west, south and, to some extent, north, converging in the lower portion of the valley to slope eastward. Figure 4-30 shows this movement

Figure 4-30

APPROXIMATE WATER TABLE AND LOCATIONS OF GROUNDWATER DISCHARGE AREAS, TRUCKEE MEADOWS AREA


Truckee
River
Steamboat
Creek
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
5500
5600
LEGEND
—5200— Approximate water table contour for the first half of December, 1971, based on water levels in wells.
Ground-water discharge area based on Mg/Ca ≥ 0.7 (source, Roger Stephens)
Approximate bedrock to alluvium contact
CONTOUR INTERVAL 50 FEET
1
0
1
2
Scale in miles
N

SOURCE: Cooley, et al., 1971.

by elevation contours from work by the DRI (Cooley, et al., 1971). The flow pattern shows little or no change from that described by the USGS for the late 1950s.

Static groundwater levels in certain lower areas in the basin generally range less than 20 feet in depth and are in contact with the Truckee River. Depths are also shallow in much of the area south of Huffaker Hills. Over some such areas the water table is virtually at the ground surface.

Groundwater levels have declined with the increase in well usage. This is illustrated by the fact that several of the SPPCo wells originally flowed when not being pumped. At present, only one such well (Peckham Lane#9) continues to flow. Heavy concentrations of well use have caused more marked lowering of water levels, at least during the peak pumping period. Two sand and gravel pit operations along the Truckee River dramatically lowered levels in their vicinities. One of these, near the site of the MGM Hotel, ceased operation to allow for construction of the hotel. The other is sited downstream and constitutes a major groundwater withdrawal.

Monitoring of water levels has been sporadic in recent years. Consequently, continuity of record is lacking for the overall basin. The USGS measured levels throughout the area in the late 1950s, as did DRI during the 1971-1973 period. SPPCo has monitored their wells since 1960, but this provides only limited basin coverage. Fortunately, a new monitoring program is now being planned cooperatively between the USGS and the state to begin within a few months. The effect of gaps in the water level record on basin hydrologic analyses is uncertain at this time.

Water Quality. Standards for drinking water quality have been adopted by the EPA (40 CFR, 141/FR/59565 and amended 41/FR/28402) and are administered by the Nevada Bureau of Environmental Health. These standards are listed in Table 4-32.

Water hardness (as $CaCO_3$), though not a health factor in itself, can present an inconvenience when exceeding about 180 mg/l, which is classified as "very hard". Boron is not important to human or animal use, but occurs in parts of the area in concentrations deleterious to certain plants and agricultural crops. Geothermally heated groundwater occurs in the southern area north of Steamboat Springs and is difficult, if not impractical, to use for domestic purposes.

Table 4-32. Drinking Water Quality Standards

	Maximum Concentration (Milligrams Per Liter)		
Constituent	National Interim Primary Regulations	National Secondary Regulations**	Nevada Drinking Water Standards
Iron (Fe)		0.3	0.60
Lead (Pb)	0.05		0.05
Manganese (Mn)		.05	0.10
Barium	1.0		1.0
Sulfate (SO_4)		250	500
Cadmium (Cd)	0.1		0.10
Chloride (Cl)		250	400
Chromium (Cr)	0.05		0.05
Fluoride (F)	1.4*	1.2	1.8-2.2
Mercury (Hg)	0.002		0.002
Nitrate NO_3)	10 (as N)		10 (as N)
Total Dissolved solids (TDS)		500	1,000
Magnesium (Mg)			150
Silver (Ag)	0.05		0.05
Arsenic (As)	0.05		0.05
Selenium (Se)	0.01		0.01

* Standard range from 1.4 mg/l at 26.3°C to 32.5°C to 2.4 mg/l at 12. C or below

**Maximum contaminant levels recommended by EPA, July 19, 1979 40 CFR Part 143.

Objectionable concentrations of arsenic and manganese commonly occur in groundwater below depths of about 250 feet in the eastern portion of the Truckee Meadows basin. In the western portion, there are also occurrences of excessive arsenic as well as fluoride, along with high water temperatures. Additionally, certain peripheral valley areas north of Reno contain generally poor quality groundwater.

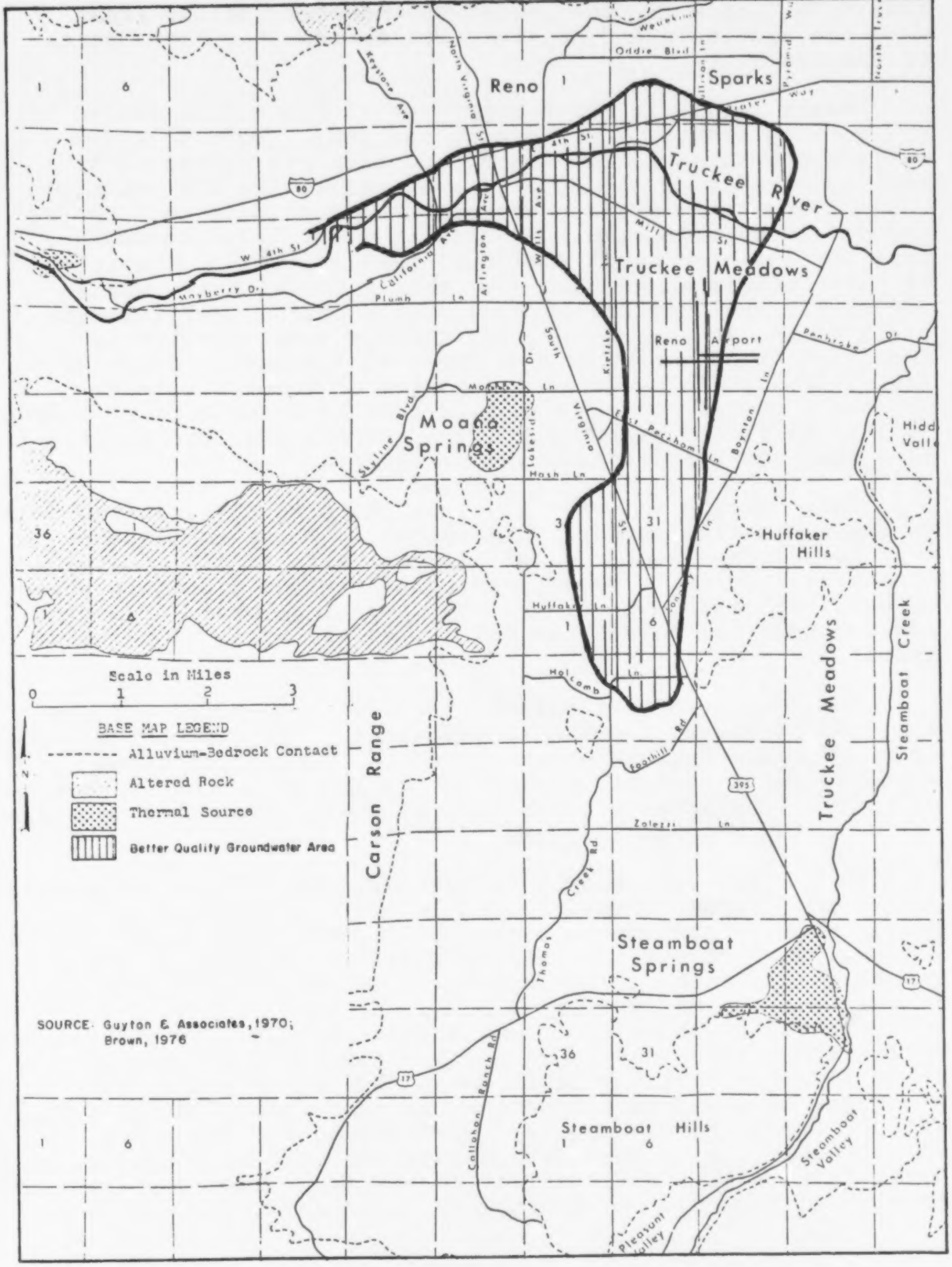
The best quality groundwater lies in a central area outlined on Figure 4-31. Groundwater is supplied for municipal and industrial use from SPPCo supply wells located within this area. Several of these wells located to the south have experienced a build-up of arsenic content in recent years, apparently as a result of the additional pumping and associated lowering of the water table. These waters have been successfully utilized by blending with production from other sources. The occurrence of marginal and poor quality groundwaters has thus restricted community well supply development.

Basin Supply. Recharge to the Truckee Meadows groundwater basin has decreased as irrigation and associated percolation declined in recent years. Changes in land use from agricultural to urban are expected to continue, ultimately leaving little or no significant farming acreage, except perhaps south of the Huffaker Hills. Total recharge would thus be reduced, although excess watering of lawns would tend to partly offset reduced percolation of agricultural irrigation water to a degree.

Present evapotranspiration discharge from shallow water table areas, estimated at some 5,000 acre-feet per year, might be reduced through controlling the water table to lower levels. This could be accomplished through selective well location and pumping. However, undesirable movement of some poorer quality groundwater might be induced in the process. Further pumping to enhance river percolation or to reduce groundwater discharge to surface streams might yield more net basin recharge but this would occur at the expense of downstream river flows.

Total developable groundwater is limited not only by the physical quantities of replenishment, but also by the minimum levels of quality suitable for various uses.

A groundwater consultant to the State of Nevada estimated the perennial supply of the Truckee Meadows groundwater basin within the better quality area to be on the order of 13,000 acre-feet per year (Brown, 1976). A written report is to be submitted on this subject by the consultant in the near future, in which some updating is expected in the analysis, thus involving a probable smaller perennial yield for the



SOURCE: Guyton & Associates, 1970; Brown, 1976

FIGURE 4-31 BETTER QUALITY GROUNDWATER AREA

area. In this work, the poorer groundwater quality areas were not addressed and no yield was derived for those parts of the basin.

Water levels in SPPCo supply wells are monitored by the company several times during the year. Most of these wells are located in the more productive and better water quality area noted previously, thus reflecting the principal basin response to pumping operations. Such data were interpreted and extrapolated to construct water level contour maps for the high level stages of 1975 and 1978. Comparison of these stages shows that over this interval there was a net water level decline in much of the basin. For the area north of the Truckee River, the average total decline is indicated to have been on the order of 7.5 feet. South of the river, levels declined an average of about 5.5 feet. The total decline in water levels from 1962, or before, through 1977 in all wells with water level records averaged about 17.5 feet (Guyton and Associates, 1978).

This decline in water level is the natural basin response to the increasing pumpage load imposed. These conditions tend to increase recharge and decrease natural groundwater discharge. By these means, the basin may again reach a state of equilibrium at a lower average operating level, providing pumping does not exceed the ability of the basin to recharge itself.

The decline of water levels from year to year, and over a period of years, represents depletion of groundwater stored in the Truckee Meadows basin. A rough calculation using accepted local specific yield factors indicates that an average of about 2,000 acre-feet per year of local groundwater storage was depleted between 1975 and 1978.

From a physical supply standpoint, the current progressive depletion of groundwater storage caused by increased well pumping can be considered a relatively small overdraft. Although water levels are still relatively shallow, even in heaviest pumped areas, recharge is increasing and natural discharge to surface streams is decreasing. If pumping rates level off, the basin can be expected to eventually compensate between inflow and outflow and reach a new state of equilibrium. It is apparent that the basin could physically withstand a greater development stress than is currently being brought without depleting the supply. Needless to say, the more water levels are lowered, the higher the cost of producing water from wells. Moreover, as levels drop, some very shallow private wells could be effectively dried up.

The real hazard to the Truckee Meadows groundwater basin posed by increasing area growth and associated well usage is related to water quality. Marginal to unusable quality groundwater in basin fringe areas tends to migrate downslope toward the better quality area. Historically, this movement has been slow enough and of such meager volume that the downstream area was not degraded. On the other hand, these flow gradients tend to steepen with additional water level lowering downstream, and this in turn threatens to increase the movement of inferior waters into the principal production areas. Increasing basin drawdowns may also encourage the upward movement of inferior water from deeper basin aquifers. This quality hazard poses a major threat to the usability of the Truckee Meadows groundwater basin. As noted previously, there is some indication that this degradation process has already had a noticeable effect.

It appears that future groundwater development will probably have to be restricted to achieve and maintain a balanced groundwater basin and to prevent substantial contamination of supplies. Because of present supply uncertainties, the state engineer is no longer approving permits for substantial new well pumping. However, present overall basin safe yield has not been accurately determined.

It is possible, however, to draw upon the data that are available to develop a rough groundwater budget for working purposes. Such an approximate budget is presented in Table 4-33 for historical and projected conditions in the Truckee Meadows. The projections were developed in conjunction with other input to the hydrologic modeling.

The projections are based on the assumption that the groundwater basin will have to be managed to maintain about the 1978 water level in order to prevent additional incursions of bad quality water and preserve the utility of the resource for M&I use.

Fernley Area

Fernley is underlain by a sequence of lake sediments extending to probable depths of 1,000 feet or more, the upper 200 to 300 feet of which were deposited by the ancient Lake Lahontan. Interbedded sands and gravels in these deposits comprise the best aquifers in the area and supply water for the Fernley City supply. Aquifer zones occur both shallow and deep; the shallow zone is everywhere under water table conditions; the deeper zone is confined under artesian pressure.

Table 4-33. Truckee Meadows Groundwater Basin
Water Balance - Working Estimates

	Year			
	1950-1960	1978	1985	2000
Recharge				
Percolating streamflow	5,000	10,000	10,000	10,000
Subsurface interbasin inflow	1,000	2,000	2,000	2,000
Percolation of applied irrigation	27,000	10,000	8,500	2,000
Percolation from irrigation ditches	6,000	2,500	1,500	500
Percolation from M&I irrigation	1,500	2,500	3,500	6,000
Total Recharge	40,500	29,000	25,500	20,500
Discharge				
Discharge to surface streams	30,500	11,000	10,500	10,500
Evapotranspiration	7,000	6,000	6,000	6,000
Well pumpage	3,000	12,000	9,000	4,000
Total Discharge	40,500	29,000	25,500	20,500

FOOTNOTES:

Assumes groundwater levels maintained at about 1978 levels. Includes Spanish Springs Valley and area west of Reno. Percolation from agricultural irrigation based on 25 percent of Orr Ditch Decree diversion; ditch percolation based on 25 percent of difference between diverted and applied water, based on Orr Ditch.Decree; M&I percolation projections based on 4.5 percent of M&I use.

SOURCE: Jones & Stokes Associates, 1980.

Groundwater moves northward and eastward toward the playa areas and the Truckee River valley. Recharge is derived mainly from seepage of excess applied irrigation water below the root zone, Truckee Canal leakage, and also leakage from distributary canals. Moreover, a significant quantity of subsurface flow enters the area from the drainage basin to the south. The water table responds directly to the irrigation cycle and associated recharge, reaching peak highs during the August-September period.

Deeper groundwater below depths of 50 to 60 feet is generally of satisfactory quality along the flank of the Virginia Range south of Fernley. However, these aquifers become increasingly mineralized toward the north, so that northerly of Highway 40 most deeper groundwater is of unsuitable quality. Shallow groundwater, on the other hand, is usually acceptable for most uses, but is susceptible to changes in the make-up of irrigation waters due to ready surface seepage. Groundwater is pumped for Fernley municipal supply from a depth between 90 and about 200 feet in the area of better, deeper zone water quality.

Wadsworth Area

Terrace deposits of the Truckee River directly underlie the Town of Wadsworth and form very productive aquifers. If some aquifer confinement exists in these deposits, it has not been defined. At high river flow stages, Truckee River percolation replenishes shallow aquifers; increased well usage increases such percolation. Movement of shallow groundwater is generally northward.

Groundwater levels are directly influenced by river percolation in Truckee River flows. It therefore follows that the quality of groundwater reflects that of river quality and would probably be affected by significant changes in the quality of such flow.

Fallon Area

This area is underlain by ancient Lake Lahontan deposits, some of which are very tight and poorly productive to wells, whereas others are relatively pervious, allowing fairly good well yields. A deep aquifer system of porous basalt (extrusive volcanic origin) lies beneath these sediments, which provide abundant well supplies to the City of Fallon and also the U. S. Navy. The shallow sedimentary aquifers are recharged from surface irrigation seepage and, in turn, recharge the deep basalt aquifer by similar downward seepage.

Dodge Flat Area

The Dodge Flat area is underlain by ancient lake, alluvial fan and deeper alluvial deposits. Alluvial fan deposits are interbedded with more fine-grained lake bed deposits. Older alluvium comprised of sands and gravels reportedly underlies these interbedded deposits (Cooper & Associates, 1980).

Groundwater is yielded to wells from the deeper alluvial deposits, and to some degree from interbedded alluvial fan deposits. Groundwater is generally encountered at 150 feet in depth in the Dodge Flat area (Cooper & Associates, 1980). Geologic profiles (Cooper & Associates, 1980) indicate a probable water table that reflects recharge of the groundwater by the Truckee River on the east and from alluvial fans on the west. Several water wells exist in the Dodge Flat area, which comprise the only identified sources of discharge.

Water Supply

The Truckee Meadows area is currently served by several water districts that obtain their water from surface and groundwater sources.

The water companies present in the Truckee Meadows are:

Sierra Pacific Power Company
Hidden Valley Water Company
Trans-Sierra Water Company
Sun Valley Water District
Panther Valley Water Users District
Silver Lake Water Company
Valley Water Company
Black Springs GID
Horizon Hills GID
Cold Springs

The SPPCo is the largest water purveyor in the Truckee Meadows area. The other companies obtain water from the SPPCo or from a separate system (Figure 4-32).

Sun and Panther Valley Water Districts obtain water from the SPPCo (DWP, 1978). Silver Lake Water Company, serving the Stead area, pumps water from its own wells and receives water from the SPPCo (Firth, pers. comm.). The Hidden Valley and Trans-Sierra systems obtain water entirely from groundwater. The Hidden Valley system (metered) served about 510 customers in 1978 (Helseth, pers. comm.). Trans-Sierra

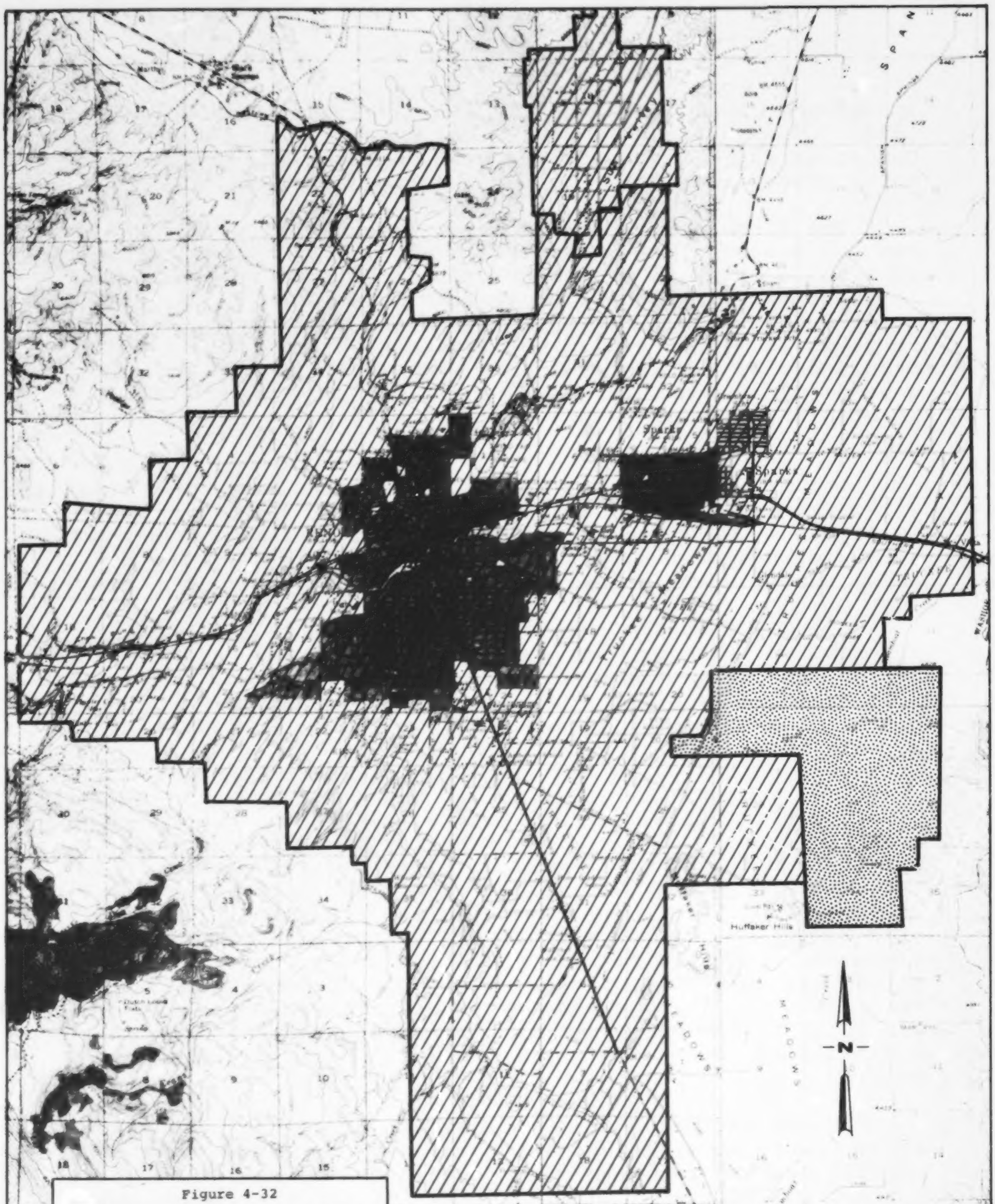

Sparks
Huffaker Hills
N
-LEGEND-
▨ SIERRA PACIFIC POWER COMPANY
▩ HIDDEN VALLEY WATER COMPANY
▤ TRANSSIERRA WATER COMPANY

Figure 4-32

WATER SERVICE AREA BOUNDARIES

(unmetered) used approximately 250 acre-feet in 1972-73 (DWP, 1978). Currently, both Hidden Valley and Trans-Sierra Water Companies are having problems with poor quality groundwater being pumped.

The SPPCo serves 43,300 acres within the Truckee Meadows and 3,000 acres in Stead (DWP, 1978). Approximately 85 percent of SPPCo's water is from surface sources, and the remaining 15 percent from groundwater (Firth, pers. comm.). A yearly distribution of water supplied from the two sources for 1978 is given in Figure 4-33. The greatest demand for M&I water occurs during the summer months when there is also a high demand for agricultural water and a fisheries need. This is also the time of generally decreasing flows in the Truckee River.

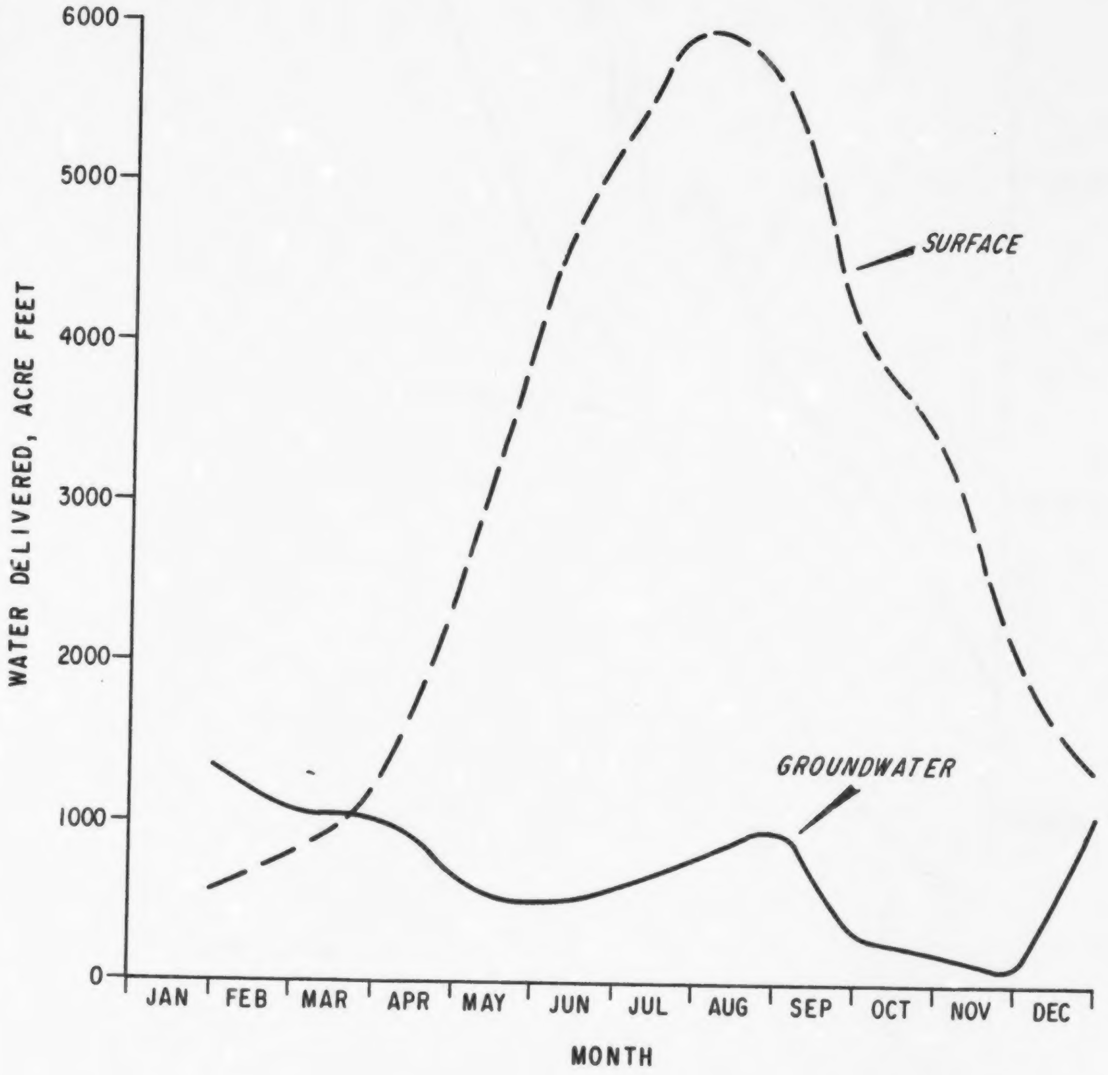
The historical water use and associated number of customers for SPPCo is given in Table 4-34 and Figure 4-34. As seen in Figure 4-34, water use generally follows number of customers as would be expected, but also varies year to year due to other factors such as available water and conservation practices.

The SPPCo system extracts water from both surface and groundwater. The groundwater is pumped from 16 wells located around the Truckee Meadows. Two of these, however, experience quality problems and are used only for emergencies (SPPCo, 1976). The remaining 14 wells have a production capacity of 38.0 mgd. Surface water is taken from Hunter Creek and stored in Hunter Creek Reservoir. Also, water is pumped from the river by the Idlewild and Glendale pumps and diverted into the Highland Ditch for storage in Highland Reservoir. Water is stored and distributed by way of 14 reservoirs with a total capacity of 19.2 million gallons (1976 capacity) (Firth, pers. comm.). Diverted water is treated at Hunter Creek, Idlewild, Highland and Glendale treatment plants, at rates of 15, 20, 30, and 25 mgd, respectively. These treatment rates are not always met, however, due to sediment during spring runoff or decayed organic matter during the fall. Also, oil and grease often enter the river due to spills along the highway or in the urban area, thus causing a closure of the system until the water clears (Firth, pers. comm.).

It was estimated that during 1976 SPPCo was purchasing water rights at a rate of 900 acre-feet per year. However, this figure has reportedly not been achieved in recent years. Currently SPPCo has 46,700 acre-feet of surface rights total (Firth, pers. comm.). This is made up of decreed and purchased rights. Most of the purchased water rights come from agricultural rights that are bought as agricultural land goes out of production or is converted to urban land. Also, SPPCo

Figure 4-33

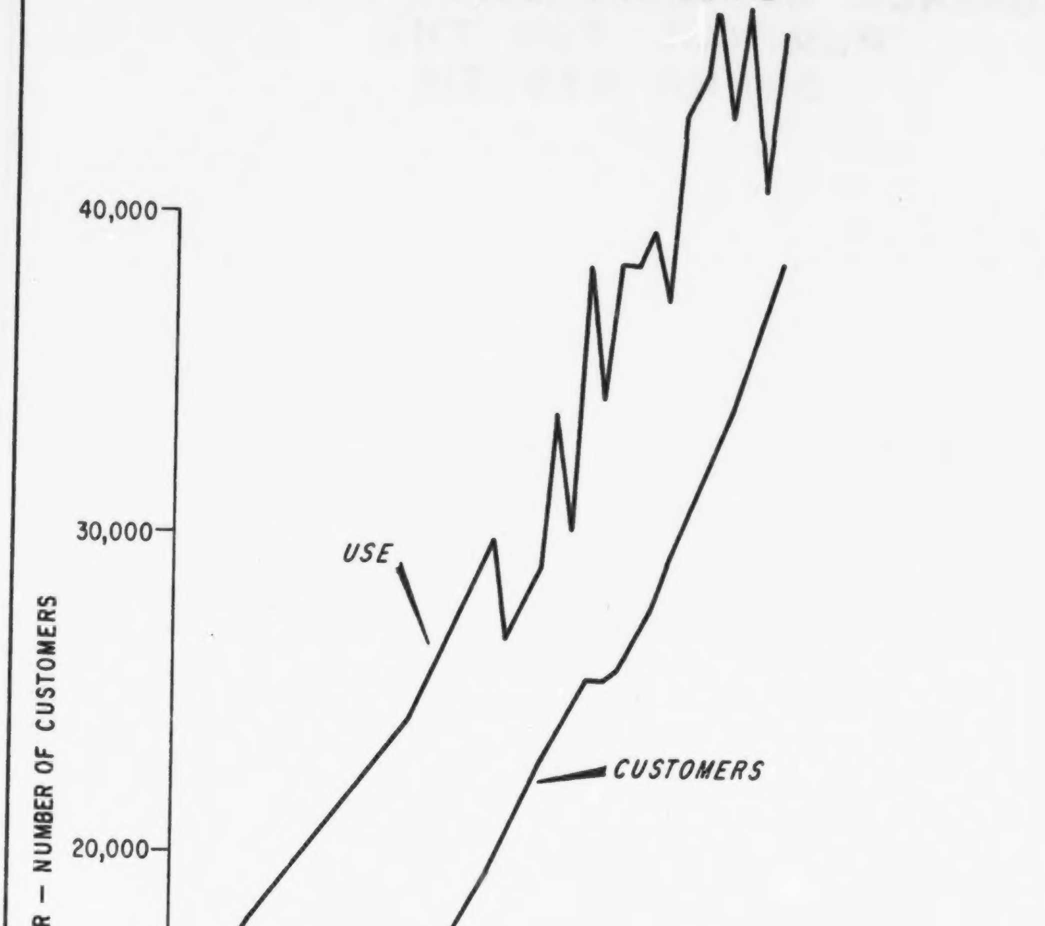
SURFACE WATER & GROUNDWATER PUMPAGE FOR THE SPPCo SYSTEM



SOURCE: SPPCo, 1979

Figure 4-34

SPPCo CUSTOMERS & WATER USE 1940 TO 1978



SOURCE: SPPCo, 1979

Table 4-34

HISTORICAL WATER USE AND NUMBER OF CUSTOMERS
IN THE SPPCo WATER SYSTEM

Year	Average Number of Customers	Percent Increase or Decrease	Total Use AF/yr.	Percent Increase or Decrease
1940	7,300		13,783	
1945	8,372	15	17,593	28
1950	11,598	39	21,006	20
1955	14,925	29	24,204	15
1960	19,302	29	29,770	23
1961	20,426	6	26,655	-10
1962	21,727	6	28,019	5
1963	22,850	5	28,944	3
1964	23,850	4	33,669	16
1965	24,626	3	30,122	-11
1966	25,437	3	38,342	27
1967	25,377	-.2	34,095	-11
1968	25,816	2	38,420	13
1969	27,039	5	38,241	-.4
1970	27,484	1	39,474	3
1971	28,982	5	37,401	-5
1972	30,427	5	43,007	15
1973	31,792	4	44,401	3
1974	32,868	3	46,279	4
1975	33,836	3	43,303	-6
1976	35,422	5	46,371	7
1977	36,924	4	40,694	-12
1978	38,446	4	45,633	12

DATA SOURCE: SPPCo, 1976; Firth, pers. comm.

has expressed an interest in obtaining 17,000 acre-feet of water from Stampede Reservoir (Firth, pers. comm.)..

In addition to the SPPCo system, there are currently a large number of small (less than 1,800 gpd) domestic wells serving individual households within the Truckee Meadows. It is estimated that as of April 1978, 5,541 persons lived within the Truckee Meadows but outside any water service boundary (DWP, 1978).

The per capita water use within the Truckee Meadows varies significantly. It is, however, higher than levels generally found elsewhere. These higher levels are probably due to the hot, dry climate. Also, the large tourist use and the fact that the system is unmetered add to this high consumption. The average and peak per capita water use for several of the water districts is given in Table 4-35.

Hazen's year-round domestic water supply (about 20 households) is taken directly from the Truckee Canal. The supply facilities consist of a diversion from the Truckee Canal, a storage pond of about 1 acre in size, and an underground delivery pipeline approximately 3 miles long. These facilities were formerly owned and operated by the Southern Pacific Railroad for watering steam engines. The facilities and the accompanying 200,000-gallon-per-day water right are now owned by Aqua-Terra Incorporated. A present water quality problem in the system is high arsenic levels (Freitag, pers. comm.). Present amounts of water diversion to Hazen are not monitored. Twenty families of four using 250 gpcd would amount to 20,000 gallons per day.

The communities of Fernley, Wadsworth, and Fallon, as well as the U. S. Navy facility near Fallon, draw their water supplies from groundwater. Additional information on their supplies is addressed in the groundwater discussions in this chapter.

The ESP will result in increased nitrogen loads in the Truckee River, Truckee Canal and Lahontan Reservoir. This may lead to increased nitrate levels in wells that are recharged by the river, by irrigation waters, and by the facilities of the Newlands Project. Fernley, Wadsworth, Fallon and the U. S. Navy facility may all experience this effect over a period of many years.

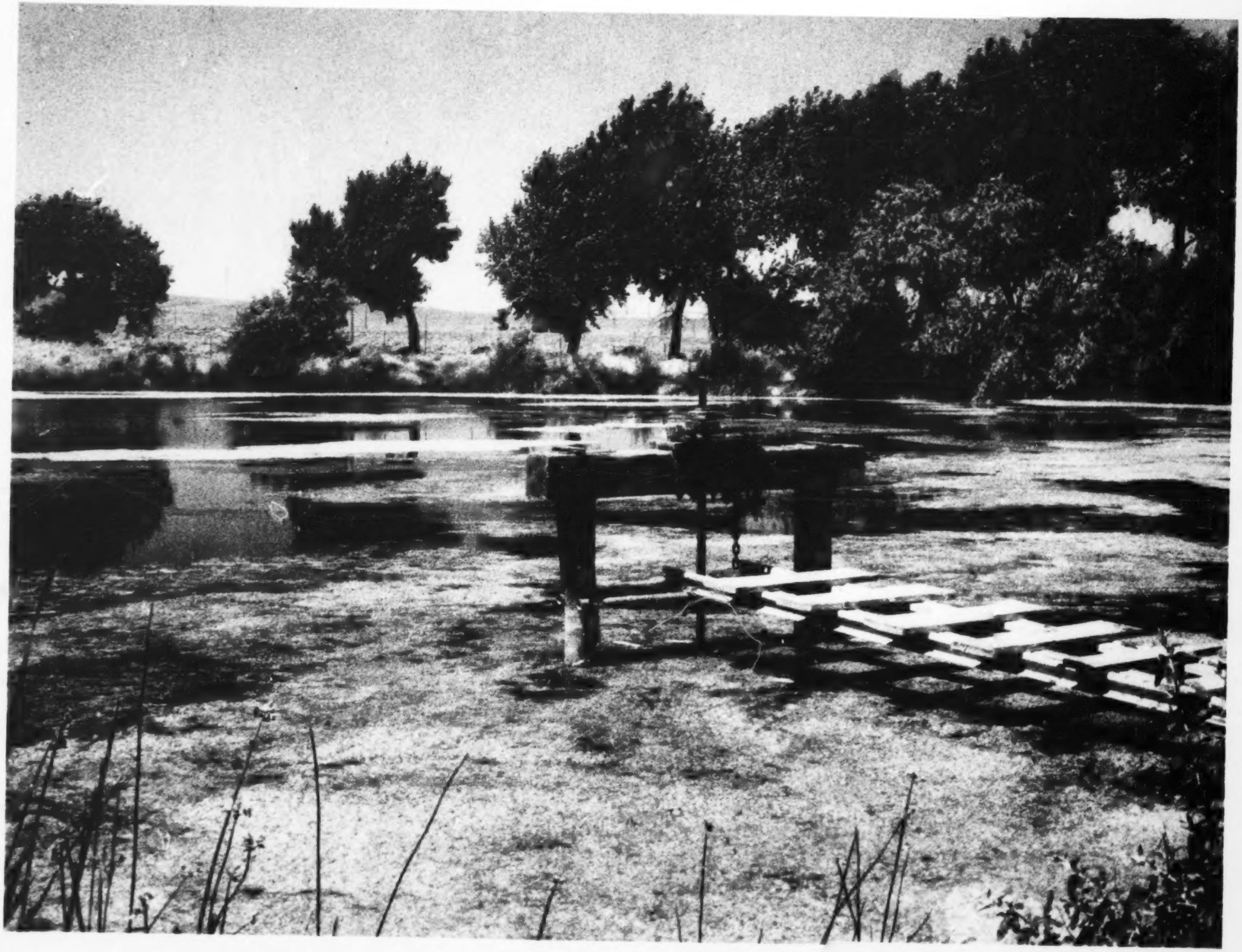
Table 4-35

WATER USE IN THE TRUCKEE MEADOWS AND CALIFORNIA

Location	Average Use Gallons/Capita/Day
Stead (1972)*	280
Hidden Valley (1978)***	282
Hidden Valley Condominiums*	170
Lemmon Valley*	165-175
SPPCo	360
San Bernardino**	226
Fresno**	326

SOURCES:

* DWP, 1978;
** California Office of Planning and Research and Department of Water Resources, 1978;
*** Helseth, pers. comm.



Water Supply Intake for the Community of Hazen.

Recreational Fishing and Hunting

Truckee River

The Truckee River from Stateline to Wadsworth is one of the most heavily fished rivers in Nevada and thus a valuable recreational resource. Estimates made by the NDW indicate that fishing, angler days, ranged from about 121,000 to 227,000 between 1970 and 1978. Fishing in the river exceeded the total annual angler days of Pyramid Lake and Lahontan Reservoir and at times equaled or exceeded their combined use during any 1 year (Table 4-36). In addition, the total annual catch of fish in the Truckee River from Stateline to Wadsworth exceeded the total combined numbers of fish caught in Pyramid Lake, Lahontan Reservoir, Stillwater Wildlife Management Area (WMA), Fernley WMA, Truckee Canal and the Lahontan Valley (as defined in Table 5-39). These data illustrate the importance of the Truckee River's sport fishery.

Game fish caught in the Truckee River are rainbow trout, rainbow-cutthroat trout hybrids, cutthroat trout, brown trout, and mountain whitefish. Among these fish the first three are most abundant in the total catch, and this fishing is primarily supported by planting hatchery-reared fish. Brown trout and whitefish that occur in the catch are wild or naturally produced fish (Summer, pers. comm.). The Truckee River is considered by the NDW to be a coldwater stream from Stateline to Derby Dam. During periods of sufficient seasonal flow below Derby Dam, the Truckee River supports a recreational fishery for planted trout from Derby Dam to Wadsworth.

Although the NDW has not differentiated fishing effort by reach along the Truckee River in its annual fishing use data, the department did conduct a separate study during 1976 and 1977 which included this disaggregation of the data. During 1976, the first of the recent drought years, approximately 84 percent of fishing occurred above the JWPCP, 10 percent between the JWPCP and Derby Dam, and 6 percent between Derby Dam and Wadsworth. During 1977, the most severe of the drought years, fishing between the JWPCP and Derby Dam dropped from 6 to about 1 percent and to less than 0.25 percent between Derby Dam and Wadsworth. These data are thought to identify the significance of instream flow on the sport fishery below the JWPCP. For example, the range of flows at Vista, below the JWPCP, during May 1976 and 1977 were 552 to 953 cfs and 174 to 389 cfs, respectively. Below Derby Dam at Wadsworth during the same periods of time the instream flow was 264 to 531 cfs and 38 to 55 cfs, respectively, which marked a considerable difference in flow between the two dry years.

Table 4-36. Fishing Use Data*

Year	Angler Days						Catch					
	Truckee River	Pyramid Lake	Lahontan Reservoir	Truckee Canal	Stillwater WMA	Lahontan Valley**	Truckee River	Pyramid Lake	Lahontan Reservoir	Truckee Canal	Stillwater WMA	Lahontan Valley
1970	157,177	141,614	54,507	651	5,193	22,746	-	-	-	-	-	-
1971	134,787	105,186	85,257	3,024	9,396	32,637	-	-	-	-	-	-
1972	121,297	105,038	94,759	-	6,664	33,090	-	-	-	-	-	-
1973	157,875	94,529	123,734	-	5,409	33,387	-	-	-	-	-	-
1974	177,277	97,297	123,513	2,480	8,659	28,797	-	-	-	-	-	-
1975	193,599	102,902	106,353	1,098	4,097	25,044	-	-	-	-	-	-
1976	162,857	892,249	56,417	-	2,884	16,588	384,552	49,216	225,336	-	13,423	47,020
1977	154,924	78,486	45,017	923	1,142	13,289	374,167	53,208	170,442	1,618	14,170	34,555
1978	226,851	58,274	52,333	1,543	2,331	20,232	528,488	51,231	122,290	9,669	10,892	52,239

SOURCE: NDW fishing use data records.

* The data presented represent the projected or expanded fishing effort based on creel census surveys conducted by the NDW at the end of the fishing season.

**Includes Carson River (Churchill County portion), V-Canal, Canvasback Marsh, Carson Lake, Harmon Reservoir, Indian Lake, Rattlesnake Reservoir, Sheckler Reservoir and Soda Lake.

It should be noted that during low flow years the NDW does not stock fish in areas where low flow and high temperature could jeopardize the survival of fish. Thus, in some years the Truckee River may be stocked above the JWPCP but not below the JWPCP (Summer, pers. comm.).

It is recognized that 1976 was also a below normal water year. Consequently, it is possible that fishing the Truckee River below the JWPCP could be higher than the percentage shown above during normal or above average water years. In addition, arguments are made by the NDW and other fishing interests that if the aquatic habitat below the JWPCP could be returned to a good quality condition this reach could become as valuable for sport fishing as the reach above the JWPCP.

Other recreational activities along the Truckee River below the JWPCP are trapping, hunting, swimming, and miscellaneous aquatic-oriented activities, i.e., sightseeing and wildlife observation. The Truckee River supports most of the trapping activity in the area. The primary species trapped along the Truckee River are beaver, muskrat, mink, bobcat and gray fox (Mollini, pers. comm.). These species are trapped for their pelts which are sold. Waterfowl hunting is generally sporadic. Other species hunted along the river include chukar partridge, California quail and deer. There is no evidence that these uses are being influenced by water quality or quantity, although it is probable that waterfowl and aquatic furbearer populations would decline with reduced flows (Mollini, pers. comm.).

When adequate flow and water quality conditions exist, the reach between Vista and Wadsworth supports much use from swimming and other miscellaneous activities.

With the growing population and a corollary need for recreational resources, the importance of the Truckee River as a recreational resource is certain to increase in the future.

The effects of the existing JWPCP and the ESP (no-project) on hydrology and water quality were discussed in previous sections. Improvements in water quality associated with the ESP are expected to improve fishing, noncontact water sport opportunities and aesthetic values. Elevated temperature will remain as a limiting factor for trout fishing, especially in dry years, but the improved water quality should improve the fishing opportunity for bass and catfish, as well as brown and rainbow trout.

Pyramid Lake

Due to its large size, its proximity to major urban areas (30 miles from Reno and Sparks and less than 200 from Sacramento), fishing for trophy fish, and its unique ecological features, Pyramid Lake is an important recreational resource in Nevada. It supports a variety of water-oriented activities including fishing, boating, swimming, sightseeing, picnicking, and camping.

Fishing is the most important recreational activity at the lake. The Lahontan cutthroat trout and the three rainbow cutthroat trout hybrids, which are hatchery-reared stock, support the fishery. The Lahontan cutthroat trout is a sought after trophy-sized fish. Since 1969, the cui-ui fishery has been closed to non-Indians to reduce pressure on that endangered species. Sacramento perch are caught during the summer months when trout are generally unavailable to the angler (DOI, 1977).

Pyramid Lake provides one of the best sport fisheries for Lahontan cutthroat trout in the country. Lahontan cutthroat trout caught from Pyramid Lake averaged about 23 inches in fork length and 5 pounds in weight in 1975. Trout in the 12-16 pound class are caught regularly and modern records of 21- and 24-pound Lahontan cutthroat and the hybrid bowcut, respectively, have been recorded. An average of 10 hours of fishing effort, however, is required for each "keeper" (19-inch fish) (DOI, 1977). It seems that fishing, angler days, at Pyramid Lake generally declined between 1970 and 1978.

Boating and water skiing are also very popular recreational activities at the lake. Most of the facilities for boating, swimming, picnicking and camping are located at Sutcliffe and Warrior Point on the west side of the lake. There are also many good undeveloped beaches around the lake, all of which are open to the public.

A recreational plan for Pyramid Lake has not been completed although the Pyramid Lake Indian Tribe is investigating recreational development in cooperation with the National Park Service (Strong, pers. comm.; DOI, 1977). A marina is planned for either Sutcliffe or Warrior Point (Strong, pers. comm.).

Existing habitat and no-project impacts are described and discussed in the water quality section for Pyramid Lake. The no-project action is not expected to alter existing recreational uses of the lake.

Lahontan Reservoir

Lahontan Reservoir, administered by the Nevada State Park System, is an important recreational resource in Nevada, with total attendance reaching 515,848 visitor days in 1979 (Meierdierck, pers. comm.). Primary recreational activities are swimming, picnicking, boating and water skiing, sightseeing, fishing and camping.

Lahontan Reservoir receives heavy fishing use, supporting an estimated 123,000 angler days in both 1974 and 1975. The fishery consists of rainbow trout, white crappie, catfish, yellow perch and white bass. The peak fishing season occurs between April and July, although fishing is year-round. Nutrient loadings to the reservoir from the Truckee and Carson Rivers have caused algal blooms and intensified the competition between rough and game fish. Measures to help alleviate these problems were outlined in the Lahontan Reservoir General Recreation Development Plan, developed by the Nevada State Park System in 1974. Other measures were proposed to expand and improve the recreational use of Lahontan Reservoir in this plan.

The ESP has the potential to increase nutrient loading on the reservoir, which can incrementally affect recreational uses. These impacts are identified and discussed under sections in this chapter dealing with the water quality of Lahontan Reservoir.

Stillwater Wildlife Management Area

The Stillwater WMA is an important area for hunting, fishing and miscellaneous activities including swimming, picnicking, and wildlife observation. Total visits to the Stillwater WMA have generally been increasing since 1960 with miscellaneous activities and fishing use experiencing the most dramatic increase. This trend is probably a result of the increased population of the area. Recreational use of Stillwater WMA is significantly affected by water availability, i.e., during dry periods the WMA will support fewer waterfowl and fish and thus will attract fewer hunters and fishermen.

The JWPCP no-project alternative is not expected to affect the WMA.

Fernley Wildlife Management Area

Recreational use of the Fernley WMA primarily includes hunting, fishing, and trapping. Hunting is the most important. Although hunting use of the Fernley WMA is relatively light compared with the Stillwater WMA it has remained relatively stable in the past 12 years.

Since 1952, a wide variety of warm and coldwater fish species have been stocked at the Fernley WMA, although in 1977 only northern pike and Sacramento perch existed in any number (DOI, 1977). Fishing use of the Fernley WMA is very light and ranged from about 200-400 angler days per year between 1970 and 1976 and dropped to only about 60 angler days per year in 1978 (NDW fishing use records).

Muskrat are also trapped at the Fernley WMA (Mollini, pers. comm.). Other recreational activities include wildlife observation, environmental education and photography. As with the Stillwater WMA, water availability is the primary factor affecting the Fernley WMA's recreational value.

The no-project alternative is not expected to affect the Fernley WMA.

Cultural Resources

A systematic literature search of historic places was conducted, including the National Register of Historic Places, issued on February 6, 1979. Only one site in the project area, Derby Dam, has been nominated to this listing although a number of sites identified in the study area have the potential to be nominated to this list. A 10 percent cultural resources survey was conducted by DRI on lands potentially impacted by Master Project alternatives. Previously recorded sites were also located and examined in the field. The full report prepared by DRI is included in Appendix D, Cultural Resources.

Historic and Prehistoric Sites

Seventeen sites of historic and/or prehistoric interest have been documented in areas potentially affected by Master Project alternatives. Ten of these sites have potential for nomination to the National Register of Historic Places. The exact nature of any impacts can only be determined after the alternatives enter the design stage. These sites are:

Truckee River Corridor.

- Site #1 - Jamison's Station, located at the edge of the Truckee River near the JWPCP, is one of the first settlements in the Truckee Meadows. Has National Register potential.
- Site #2 - Emigrant trail and camp area at Mustang Flat. Has National Register potential.

- Site #4 - Derby Dam, as part of the Newlands Project, was the first facility completed under the Reclamation Act of 1902. Was included on the National Register of Historic Places on April 26, 1978.
- Site #3 - Clark Station, a rest area on the Truckee River route of the Emigrant Overland Trail. Has National Register potential.
- Site 26Wa2 - Court of Antiquity petroglyphs at the edge of the Truckee River near the JWPCP. Has National Register potential.
- Site 26Wa1601 - Petroglyphs on a bench 30 feet above the Truckee River hear Hafed. Has National Register potential.
- Site 26Wa2131 - Petroglyph site on cliff face between Mustang and Patrick. Has National Register potential.
- Site 26St27 - Temporary campsite, material workshop site on terrace along southeast edge of Truckee River. Has National Register potential.
- Site 26Wa2679 - Small material workshop near Mustang.
- Site 26St5 - Unknown (previously recorded site. Record form unavailable at Nevada State Museum at time of inquiry).
- Site 26Wa2677 - Historic dump adjacent to railroad tracks near Derby Dam.

Dodge Flat

- Site #5 - Town of Wadsworth. Was one of the camp sites along the Truckee River route of the Emigrant Overland Trail and from 1868 to 1905 was division headquarters of the Central Pacific Railroad. Has National Register potential.
- Site 26Wa2678 - Small temporary campsite in dunes along edges of a small dry lake. Has National Register potential.
- Site 26Wa2681 - Temporary campsite on tops of Truckee River terraces. Has National Register potential.
- Site 26Wa2680 - Small material workshop site on the floodplain of Truckee River.

- Site 26Wa2469 - Small open site in disturbed area north of Pyramid Street in Wadsworth.
- Site 26Wa2682 - Historic semisubterranean log structure.

The three petroglyph sites are significant since they contain unique evidence of the preliterate symbolizing of prehistoric peoples. Two distinct assemblages, based on different stone flaking traditions, are apparently represented at a seasonal campsite located on the western terrace of the Truckee River. Subsequent investigations of the site may clarify these lithic traditions and contribute to our understanding of the various patterns of Truckee River resources exploitation.

A temporary campsite on the edge of a small dry lake west of the Truckee River contains both groundstone and retouched flakes, and indications of at least limited depth. Two Rose Springs Corner-Notched projectile points were collected from the surface of the site. Further investigation of the site in relation to others in the general Truckee River area, can further contribute to the understanding of the seasonality and scheduling of resource-gathering activities.

Evaluation Considerations

The present 10 percent survey conducted for the Master Project represents only a preliminary stage in the investigation and determination of cultural resources in the project area. Prior to any project construction, a 100 percent survey will be needed to precisely determine the number and extent of cultural resources and necessary mitigations. The number of sites already recorded in the project area is lower than would be expected in a region of known aboriginal occupation. Although agricultural, residential, and industrial development has already destroyed many sites, many extant sites may be revealed by intensive survey. Evidence of buried sites may also be revealed by a careful examination of road cuts, erosion channels, and other exposure areas. Previous archeological investigations in the Lahontan Basin and Reno areas reveal a long and complex pattern of prehistoric occupation of the area; however, many important questions remain unresolved. Existing archeological sites, therefore, must be preserved. All sites (both historic and prehistoric) located within and adjacent to the project area must be protected from adverse impact due to construction, vehicular traffic, unsystematic collection, or other project-related activities until these sites can be properly evaluated by qualified archeologists and historians.

Spanish Springs Valley. The DRI conducted a cultural resources reconnaissance survey for the northern and eastern parts of the proposed Spanish Springs Valley sludge disposal site in December 1979. The reader is referred to the section pertaining to Spanish Springs Valley - JWPCP sludge handling and disposal project in this chapter for information regarding this survey.

Land Use

The Truckee Meadows is the center of urban activity in northern Nevada. The Cities of Reno and Sparks occupy relatively flat land along the Truckee River, with their urban land uses and suburbs spread out in the Truckee Meadows. Much of the Truckee Meadows remains in irrigated agriculture, including pasture, alfalfa and grains.

Generalized delineations of existing urbanized areas were developed for the EIS to aid in the evaluation of growth effects in the Truckee Meadows. Figure 5-1, which shows the generalized limits of the urbanized area in the Truckee Meadows, was developed from aerial photography taken in 1979.

Outside of the Truckee Meadows, irrigated agricultural uses are developed along the Truckee River where topography permits, and in the areas along the Truckee Canal and its distributaries. Large tracts of land in the Fernley and Fallon areas are used for alfalfa and pasture. Other areas, including the more mountainous portions of the study area, are used for livestock grazing.

The SCS designates particular lands as "prime agricultural lands" following the definition set forth in 1977 by the CEQ. Prime agricultural lands are those lands which have soil, climate and water availability characteristics that permit the production of "relatively more food with less erosion and with lower demand for fertilizer, energy and other resources" than nonprime land (CEQ, 1977). The term prime agricultural lands is not analogous to farmlands, in fact not all farmlands are prime agricultural lands. Additional lands which are designated as prime agricultural lands include some, but not all lands used for grazing and silvicultural practices.

The SCS in Reno is currently completing their designations of prime agricultural lands within the study area (MacDougall, pers. comm.). The quantity of prime agricultural land (i.e., acreage) which will be converted to urban use (according to the proposed growth) cannot be determined until the final designation process is completed.

Socio-Economics

The predominant industries in the Truckee Meadows are services and gaming. Other important industries in the area include warehousing, construction, transportation/communication/utilities, finance/insurance/real estate, retail trade, and wholesale trade.

The population of the Reno SMSA (Washoe County) increased from 121,068 residents in 1970 to 176,368 in 1978, an overall increase of nearly 46 percent at an average rate of 4.8 percent annually. Like the economy, population grew at a more moderate rate (3.6 percent per year) between 1970 and 1976. The rate then increased to 8.3 percent per year during the period 1976-1978.

For fiscal year 1979, $1.88 million was expended by Reno and Sparks to treat 7,203 million gallons of sewage. Electrical energy is a major cost of operating the JWPCP; $426,000 was expended for electricity in fiscal year 1979. No estimates of operating costs of the ESP are available in the Draft Facilities Plan (Kennedy/Jenks, 1980).

The JWPCP is jointly owned by the Cities of Reno and Sparks. The cities share in the cost of operation and maintenance of the plant, pro rata in proportion to the wastewater flow contribution from each city. Residents of Sparks currently pay $3.75 per month for sewer service for single family dwelling units. Residents of Reno currently pay $4.00 per month for sewer service for single family dwelling units. Both of these rates are charged on a flat rate basis.

Air Quality

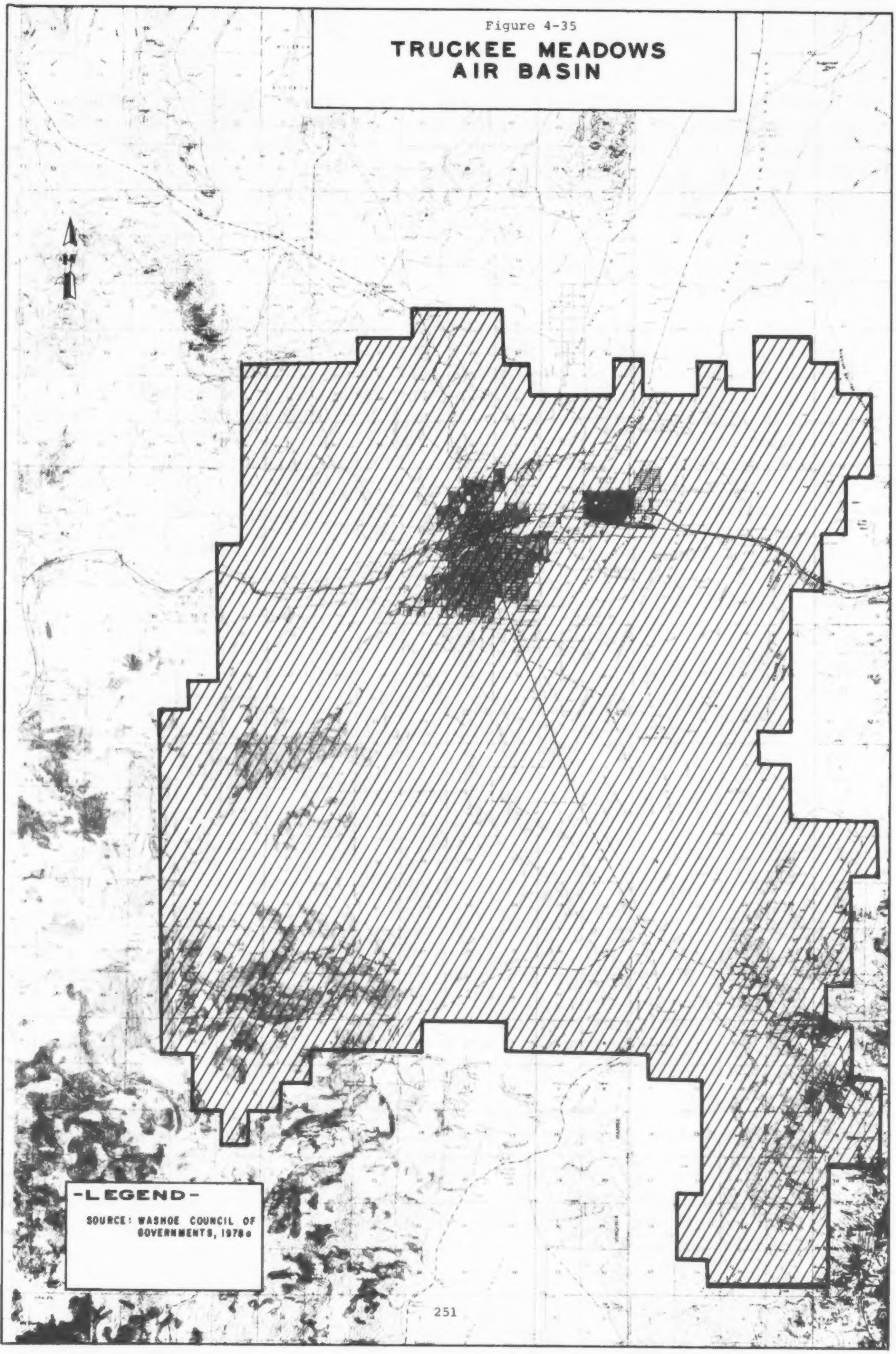
Introduction

Historically, air pollution problems have been associated with the belching smokestacks of industrial processes. Only since World War II have nonindustrial sources such as automobiles begun to play a major role in air quality problems. Indeed, mobile sources (automobiles, trucks, etc.) are nationally the singlemost important emission source.

The concentrations of carbon monoxide (CO) and total suspended particulates (TSP) regularly exceed national ambient air quality standards (NAAQS) within the Truckee Meadows air basin (Figure 4-35). Because of these exceedences, the Truckee Meadows air basin has been designated a nonattainment area with respect to these pollutants. As mandated by the

Figure 4-35

TRUCKEE MEADOWS AIR BASIN



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SOURCE: WASHOE COUNCIL OF GOVERNMENTS, 1978a

Clean Air Act Amendments of 1977, an air quality management plan was prepared, which outlines strategies aimed at reducing pollutant emissions. The purpose of the Truckee Meadows Air Quality Implementation Plan (AQIP) is to present a coordinated, regional strategy for the attainment of NAAQS.

Relationship of Reno-Sparks Sewage Treatment Plant Expansion to Air Quality

Expansion of the Reno-Sparks JWPCP is relevant to air quality issues since growth accommodated by the Master Project would increase pollutant emissions from various source categories. For example, growth in Truckee Meadows will stimulate use of automobiles both from residents and from the tourist industry. In addition, stationary source emissions (e.g., fireplace), will increase as growth occurs. These increases in pollutant emissions must be in conformance with emission projections as determined by the Truckee Meadows AQIP. The EPA is authorized to withhold, restrict, or condition any grant for construction of sewage treatment facilities if the new treatment capacity causes a larger increase in emissions than has been provided for under the state implementation plan.

Air Quality Monitoring

The WCDHD began monitoring air pollutants in 1973. TSP are currently monitored at 12 locations in Washoe County. Ozone (O_3) and CO are monitored at both the Reno (Evans and Plaza Streets) and Sparks (4th and Prater Streets) sites. Nitrogen dioxide and hydrocarbons (HC) are also monitored at the Reno site. Applicable ambient air quality standards are presented in Table 4-37.

Trends in Pollutant Levels

In general, O_3 concentrations in Truckee Meadows have increased since monitoring was initiated in 1973. Both the peak hourly values and the number of violations of the old 0.08 ppm NAAQS have increased over time, although 1976 was a relatively good year with respect to the number of violations recorded (see Appendix B).

The WCOG has requested a change of classification for ozone from nonattainment to unclassified based on WCDHD monitoring data in Truckee Meadows and the February 1979 change in the ozone NAAQS. (The NAAQS was changed from 0.08 ppm to 0.12 ppm.) The unclassified designation would remain until ambient monitoring data are conclusive with respect to attainment.

Table 4-37

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	National Standards[1, 5] Primary[3]	National Standards[1, 5] Secondary[4]	Nevada Standards[2]	Washoe County Standards[2]
Ozone	1 hour	235 µg/m^3 (0.12 ppm)	Same as primary standard	235 µg/m^3 (0.12 ppm)*	125 µg/m^3 (0.064 ppm)
	Annual Arithmetic Mean	-	-		60 µg/m^3 (0.031 ppm)
Carbon Monoxide	1 hour	40 mg/m^3 (35 ppm)	Same as primary standard	40 mg/m^3 (35 ppm)	15 mg/m^3 (12.9 ppm)
	8 hour	10 mg/m^3 (9 ppm)	Same as primary standard	10 mg/m^3 (9 ppm)	10 mg/m^3 (8.6 ppm)
	Annual Arithmetic Mean	-	-	-	2 mg/m^3 (1.7 ppm)
Carbon Monoxide Above 5,000 feet MSL	1 hour	-	-	40 mg/m^3 (35 ppm)	-
	8 hour	-	-	6.67 mg/m^3 (6 ppm)	-
Nitrogen Dioxide	1 hour	-	-	-	200 µg/m^3 (0.10 ppm)
	Annual Arithmetic Mean	100 µg/m^3 (0.05 ppm)	Same as primary standard	100 µg/m^3 (0.050 ppm)	100 µg/m^3 (0.05 ppm)
Sulfur Dioxide	3 hour	-	1,300 µg/m^3 (0.5 ppm)	1,300 µg/m^3 (0.5 ppm)	-
	24 hour	365 µg/m^3 (0.14 ppm)	-	365 µg/m^3 (0.14 ppm)	80 µg/m^3 (0.030 ppm)
	Annual Arithmetic Mean	80 µg/m^3 (0.03 ppm)	-	80 µg/m^3 (0.03 ppm)	30 µg/m^3 (0.011 ppm)
Suspended Particulate Matter (High Volume Method)	24 hour	260 µg/m^3	150 µg/m^3	150 µg/m^3	100 µg/m^3
	Annual Geometric Mean	75 µg/m^3	60 µg/m^3	75 µg/m^3	50 µg/m^3 Annual Arithmetic Mean
Suspended Particulate Matter (AISI Method)	24 hour	-	-	-	1.25 COH units per 1,000 feet
	Annual Arithmetic Mean	-	-	-	0.5 COH units per 1,000 feet
Hydrocarbons (corrected for methane)	3 hour (6-9 a.m.)	160 µg/m^3 (0.24 ppm)	same as primary standard	160 µg/m^3 (0.24 ppm)	125 µg/m^3 (0.19 ppm)
Lead	Calendar Quarter (Arithmetic Mean)	1.5 µg/m^3	same as primary standard	1.5 µg/m^3	-

[1] National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year. The hourly national ozone standard is not to be exceeded on more than 3 calendar days during any 3-year period.

[2] Nevada and Washoe Counties standards are values that are not to be exceeded where the general public has access.

[3] National primary standards: the levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[4] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[5] Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

*The 1 hour standard for Lake Tahoe Basin is 195 µg/m^3 (0.10 ppm).

SOURCE: Modified from WCOG, 1978a; Sheen, pers. comm.; Jesson, pers. comm.

Based on historical monitoring data, concentrations within Truckee Meadows have not violated the new ozone NAAQS. Further monitoring data are needed to support a request of classification to attainment.

No violations of the 1-hour NAAQS for CO have been recorded in Truckee Meadows. The 8-hour NAAQS, however, is frequently violated in the winter months. Although the number of violations of the 8-hour NAAQS have remained relatively constant in the past few years, the peak 8-hour values have steadily increased since 1974 (see Appendix B).

Both the 24-hour and annual geometric mean TSP NAAQS are regularly violated in Truckee Meadows. Concentrations in the air basin are quite variable; elevated levels are localized in nature. An increasing percentage of TSP monitors have recorded levels in excess of the annual NAAQS (see Appendix B).

Pollutant Sources

Except for TSP, motor vehicles account for the majority of pollutant emissions in Truckee Meadows (Table 4-38 and Figure 4-36). Fugitive dust categories account for 94 percent of TSP emissions, while sulfur oxide emissions are minute.

Effects of the ESP on Air Quality

The ESP will accommodate growth in Truckee Meadows, and hence will indirectly impact air quality through increases in pollutant emissions. The ESP will not accommodate growth in excess of what it is accounted for in the Truckee Meadows AQIP. As long as the ESP does not significantly increase the rate of growth in the Reno/Sparks area, air quality impacts of growth will be mitigated by measures currently adopted in the AQIP.

Dodge Flat Wastewater Reuse Area

Project Location

Dodge Flat is one of the proposed disposal sites for Alternatives L-6 and L-7 of the Reno-Sparks JWPCP. Gravity flow from the plant will bring wastewater to a reservoir near Wadsworth. The effluent will then be pumped onto Dodge Flat for irrigation purposes.

Table 4-38. Emissions Inventory Truckee Meadows Air Basin for 1977

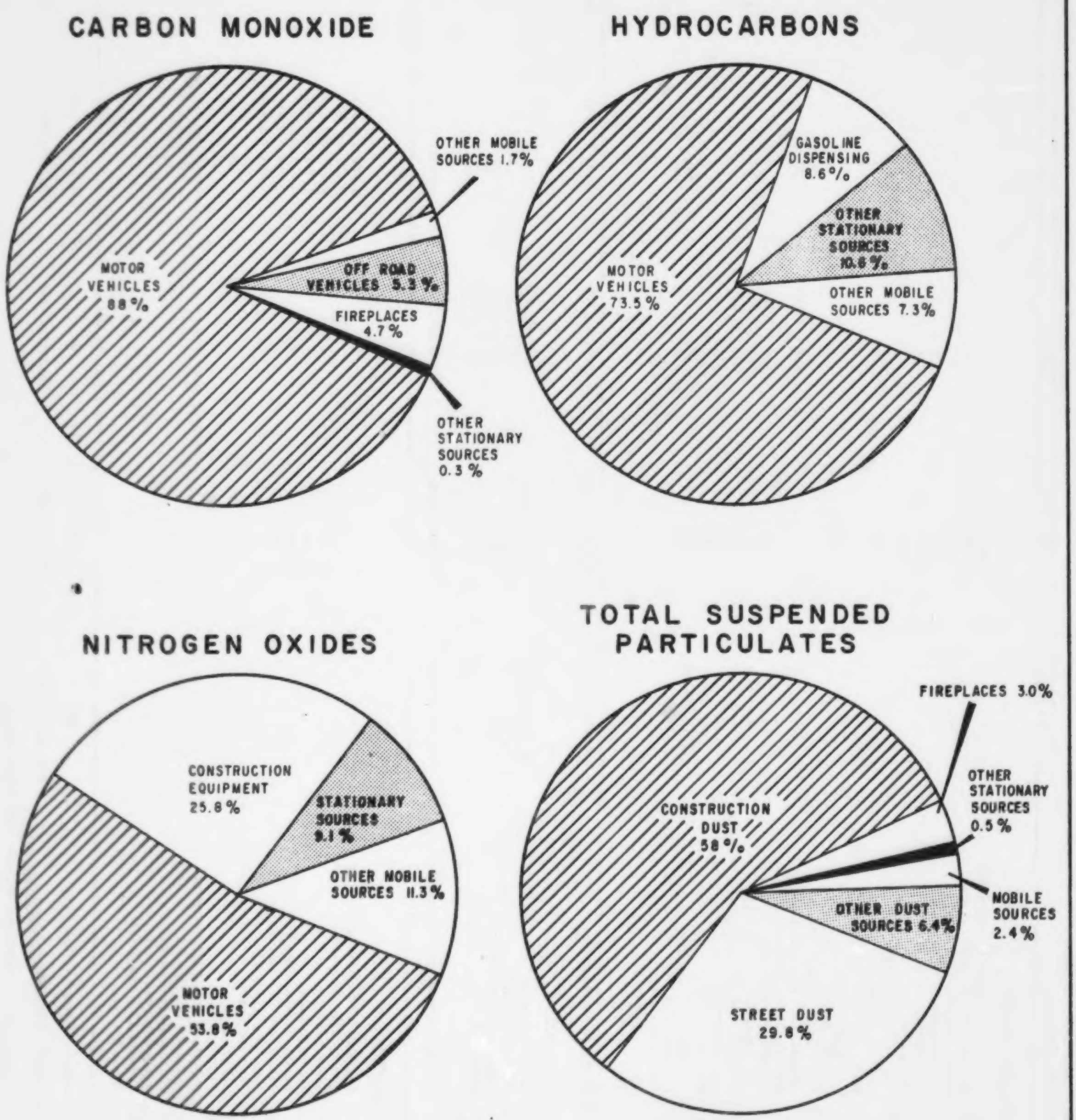
Pollutant Sources	Emissions (Tons/year)				
	CO	HC	NOX	TSP	SO2
Stationary Sources					
1. Petroleum Storage & Offloading	-	411 (4.2%)	-	-	-
2. Gasoline Dispensing	-	845 (8.6%)	-	-	-
3. Paint (Structures & Misc)	-	77	-	-	-
4. Paint (Autos)	-	37	-	-	-
5. Dry Cleaning	-	55	-	-	-
6. Degreasing	-	31	-	-	-
7. Oil used as Carrier for Pesticides	-	7	-	-	-
8. Cement Processing	-	-	-	2	-
9. Asphalt Batching	-	-	-	4	-
10. Asphalt Paving	-	189 (1.9%)	-	-	-
11; Natural Gas Combustion (Residential/Space Heating)	49	20	197 (3.3%)	25	1
12. Natural Gas Combustion (Commerical Processes)	12	2	82 (1.4%)	7	0
13. Light Fuel Oil Combustion	43	9	153 (2.8%)	21	121 (17.9%)
14. Residual Fuel Oil Combustion	5	1	62 (1.0%)	8	161 (23.8%)
15. LPG Combustion	4	1	15	4	0
16. Coal Combustion	23	5	1	5	14 (2.1%)
17. Fireplaces	3,513 (4.7%)	146 (1.5%)	30	591 (3. %)	-
18. Incinerators	28	9	9	19	7 (1.0%)
19. Permitted Fires	2	0	-	1	-
20. Structural Fires	8	3	0	1	-
21. Wild Fires	3	0	-	0	-
Subtotal for Stationary Sources	(3,690) (5.0%)	(1,888) (19.2%)	(549) (9.1%)	(682) (3.5%)	(304) (45.0%)
Mobile Sources					
22. Motor Vehicles	65,192 (88.0%)	7,231 (73.5%)	3,242 (53.8%)	367 (1.9%)	198 (29.3%)
23. Off-Road Vehicles	3,927 (5.3%)	239 (2.4%)	78 (1.3%)	7	6
24. Construction Equipment	275	89	1,550 (25.8%)	52	93 (13.8%)
25. Railroads	144	102 (1.0%)	401 (6.7%)	27	62 (9.2%)
26. Aircraft	891 (1.2%)	292 (3.0%)	199 (3.3%)	13	12 (1.9%)
Subtotal for Mobile Sources	(70,429) (95.0%)	(7,953) (80.8%)	(5,470) (90.9%)	(466) (2.4%)	(372) (55.0%)
Fugitive Dust					
27. Residential Construction	-	-	-	2,705 (13.8%)	-
28. Commercial Construction	-	-	-	8,695 (44.2%)	-
29. Paved Streets	-	-	-	4,480 (22.8%)	-
30. Unpaved Roads	-	-	-	1,381 (7.0%)	-
31. Street Sanding (Red Cinder)	-	-	-	183	-
32. Street Sanding (Sand)	-	-	-	388 (2.0%)	-
33. Sand and Gravel Pits (Active)	-	-	-	464 (2.4%)	-
34. Sand and Gravel Pits (Inactive)	-	-	-	-	-
35. Agriculture	-	-	-	43	-
36. Cleared Areas	-	-	-	40	-
37. Playgrounds	-	-	-	51	-
38. Unpaved Parking Lots	-	-	-	39	-
39. Railroad Right-of-Way	-	-	-	36	-
40. Heavy Equipment Storage	-	-	-	3	-
41. Unpaved Road Shoulders	-	-	-	3	-
42. Horse Corrals	-	-	-	9	-
Subtotal for Fugitive Dust	(0)	(0)	(0)	(18,520) (94.2%)	(0)
TOTAL EMISSIONS	(74,119) (100%)	(9,841) (100%)	(6,027) (100%)	(19,668) (100%)	(676) (100%)

Percentages of Pollutant Sources over 1% of the total are shown in ( ) to the right of the tonnage

SOURCE: WCOG, 1978a.

FIGURE 4-36

RELATIVE CONTRIBUTION OF POLLUTANT SOURCES (1977)


CARBON MONOXIDE

HYDROCARBONS

NITROGEN OXIDES

TOTAL SUSPENDED PARTICULATES

NOTE: FIGURES MAY NOT ADD CORRECTLY DUE TO ROUNDING

SOURCE: WASHOE COUNCIL OF GOVERNMENTS, 1978a

Wastewater disposal would consist of spray irrigation in summer and either subsurface recharge in Olinghouse Canyon (Alternative L-6) or release to the Fernley Drain, which flows to the game management area in winter (Alternative L-7).

Climate

The area has a characteristic western desert climate, being dry during most of the year with a high incidence of windy days. Precipitation averages 6 inches annually (U. S. Bureau of Reclamation, 1975). Annual pan evaporation is estimated at 48 inches (U. S. Bureau of Reclamation, 1975). The average date of the last spring frost is May 13, and of the first fall frost is September 27. The length of the growing season averages 137 days. Daily temperatures range from 15°F-45°F in January, and 50°F-95°F in July (U. S. Bureau of Reclamation, 1975). Recorded extremes at Nixon are -24°F and 100°F.

Land Resources

Dodge Flat is located in the panhandle area of the Pyramid Lake Indian Reservation, approximately 2 miles northwest of Wadsworth and 35 miles east of Reno. The effluent disposal site comprises a segment of a large gently sloping plateau, approximately 6,906 acres, lying about 150 feet above the bed of the Truckee River. Elevations in the area vary from 4,150-4,210 feet above sea level (U. S. Bureau of Reclamation, 1975).

Dodge Flat lies within the Great Basin which is characterized by isolated, subparallel fault-block mountain ranges separated by desert basins of internal drainage. The Truckee River flows through the reservation lands adjacent to Dodge Flat in a generally northerly direction until it empties in Pyramid Lake.

The geology of Dodge Flat reflects the history of Pleistocene Lake Lahontan. Basically, the area contains unconsolidated sediments of alluvial fan and lake origin. Older alluvium apparently underlies the fan and lake deposits. Volcanic bedrock of Tertiary age is present in the Pah Rah range to the west and apparently underlies the valley fill at depths up to 1,000 feet (Cooper and Associates, 1980).

The lake deposits and alluvial sediments are essentially flat-lying. Several episodes of lake level fluctuations caused interbedding of the granular fan sediments and the fine-grained lake beds. Wave-action caused good sorting of the fine to coarse-grained sands. The older alluvium is essentially sands and gravels that are slightly deformed from ancient folding and faulting.

As shown in Figure 4-37, two fault zones are present in the area. The northwest-trending Walker Lane fault zone is a major structural feature in western Nevada and is considered potentially active on the basis of historic earthquake and displacement of Quaternary age deposits.

The Olinghouse fault zone trends in a northeast direction and apparently intersects the Walker Lane north of Dodge Flat. Based on fault scarps in the alluvial fan deposits, the Olinghouse fault is also considered potentially active. See land resources section (Spanish Springs Valley) for a discussion of earthquakes in the area.

Soils in the Dodge Flat area consist of lake deposits, clay, silt, sand, gravel and calcareous tufa. Some areas are thinly veneered by aeolian sand. Rocks belonging to the Miocene Pyramid Sequence, consisting of basalt, andesite, and dacite flows with lenses of silicic waterlain tuff, shales, and sandstones, outcrop in the southwest corner of the project area. Stream and aeolian deposits characterize the floodplain of the Truckee River.

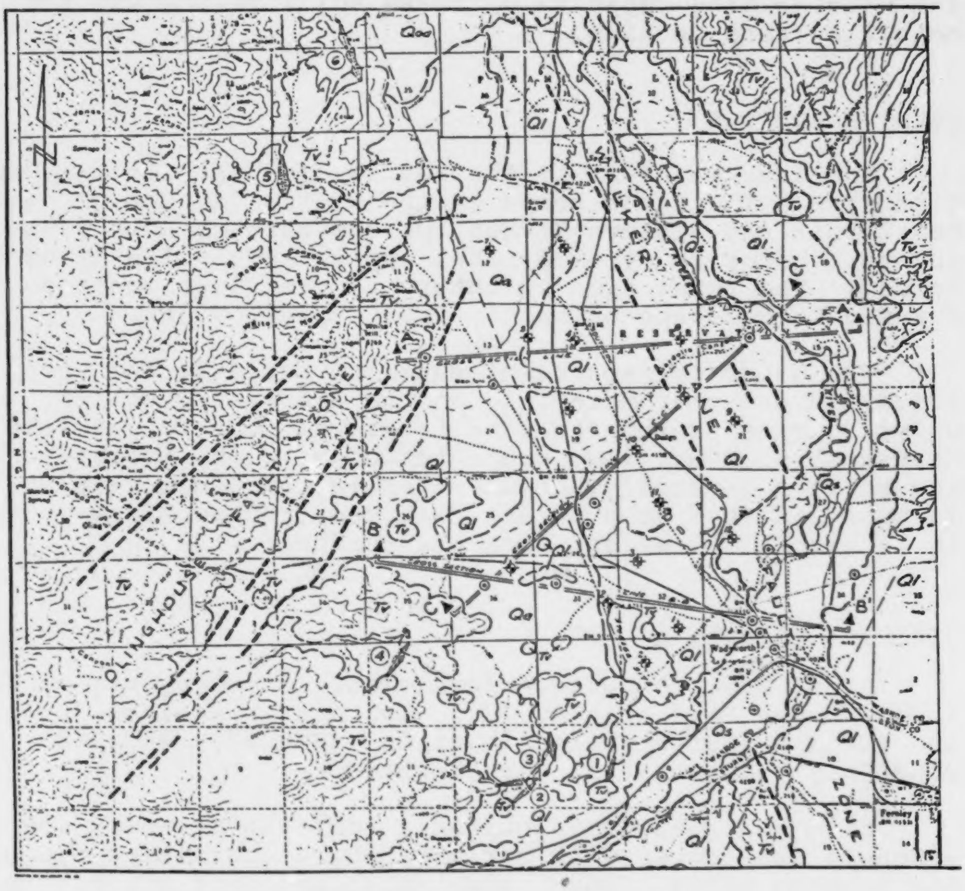
Soils in the southeast portion of Dodge Flat, east of the abandoned Southern Pacific Railroad right-of-way, are formed from a deposit of the Truckee River, which in the past occupied a position north of its present channel. The soils formed from this deposit are light in texture with low waterholding capacity.

The three separate deposits of material, from which the soils of the area are formed, are described below.

The lacustrine soils are stratified sandy loams, or loams with an occasional lens of clay loam or clay. They are light gray in color with good to poor permeability. The organic content of these soils is low. Where the permeability is poor, playas have formed and these areas are not considered arable.

The alluvial soils are brown to grayish-brown in color and range from loamy sands to loams in texture. The light textured soils have a single grain structure, while the medium textured soils have a granular structure. Soils in this group have a relatively high waterholding capacity. The permeability of these soils is high. The alluvial soils are relatively free of salt accumulations, have low erosion potentials, and are

Figure 4-37. The Fault Zones of the Dodge Flat Wastewater Disposal Site



SOURCE: Cooper and Associates, 1980.

high in native fertility. The lands are smooth and require only small amounts of leveling for irrigation.

The river deposits are mostly loamy-sands and sands. The waterholding capacity of these soils is low and the permeability rate is high.

Water Resources

The Truckee River is the source of water for the Dodge Flat area. The river heads in the Sierra Nevadas of eastern California and western Nevada, passes through Lake Tahoe and terminates in Pyramid Lake, approximately 120 miles downstream. The total area tributary to the river upstream from Pyramid Lake is approximately 1,960 square miles.

The principal source of water to wells is the unconsolidated granular materials in the alluvial deposits. Groundwater is also present in sand or gravel beds in the lake deposits; however, they are interbedded with impervious clays and silts. Generally, groundwater in the Dodge Flat area is over 150 feet deep except near the Truckee River where it is within a few feet from the surface.

Cultural Resources

A cultural resources reconnaissance survey was conducted in the Dodge Flat area by DRI. Two historic sites (26Wa2682 and #5) and four prehistoric sites (26Wa2678, 26Wa2680, 26Wa2469, and 26Wa2681) were located.

Site 26Wa2682 is an historic semi-subterranean log structure, probably associated with early ranching activities along the Truckee River. The inside walls and roof are covered with corrugated sheet iron, attached with round nails. Two old square nails in the roof probably indicate an earlier date of construction (pre-1920) with subsequent modifications. Site #5 is the Town of Wadsworth. It served as one of the campsites along the Truckee River route of the Emigrant Overland Trail. There is a pioneer cemetery which marks the camp spot, although it is poorly preserved. Wadsworth was the division headquarters of the Central Pacific Railroad from 1868-1905.

Prehistoric sites are typified by flakes of various materials such as basalt, chert, and obsidian. Site 26Wa2678 is a small temporary campsite located along the edge of a small dry lake in Dodge Flat. Numerous retouched and apparently utilized flakes as well as the Rosesprings corner-notched projectile points were found here.

Site 26Wa2680 is a small material workshop site on the floodplain of the Truckee River. The assemblage consists primarily of unmodified thinning flakes of chert, along with one retouched flake. Severe erosion and human disturbance has occurred in the area.

Site 26Wa2681 is a temporary campsite located on the tops of the Truckee River terraces. At least two distinct kinds of assemblages were noted: 1) large basalt flake and core tools, many of which were retouched; and 2) small, mostly unretouched but probably utilized chert thinning flakes. Many of the materials have been severely sandblasted.

Selected characteristics of the Dodge Flat sampling units are summarized in Table 4-39. No figure is included as the site-specific information may jeopardize these cultural resources.

Land Use and Ownership

The proposed irrigation site at Dodge Flat is situated within the boundaries of the Pyramid Lake Indian Reservation. This land is administered by the Bureau of Indian Affairs and is not zoned for a particular use although the tribe is considering cultivating it.

Evidence of cattle grazing is apparent all over Dodge Flat; however, only parts of the Truckee River floodplain have been intensively developed for agriculture and as pasturelands. The main agricultural crop is alfalfa although grain and corn are grown to a lesser extent. Industrial and residential development has been primarily confined to the immediate Wadsworth vicinity.

Interstate 80 and the Southern Pacific Railroad are within 3 miles of the area, and State Highway 34 runs through the area. Tribal headquarters is located at Nixon, approximately 9 miles north along Highway 34. Most of the reservation inhabitants live in the Towns of Nixon and Wadsworth.

Biological Resources

Vegetation in the Dodge Flat area is diverse, depending on local microenvironmental conditions. Cottonwoods (*Populus* sp.), willows (*Salix* spp.), and buffaloberry (*Shepherdia arguta*) line the riverplain while black greasewood (*Sacrobatus vericulatus*), saltbush (*Atriplex* spp.) and grasses (*Bromus tectorum*, *Oryzopsis hymenoides*) are most conspicuous on the lake deposits. Sagebrush (*Artemisia* spp.) communities occur

Table 4-39. Selected Characteristics of Dodge Flat Sampling Units as Determined by Preliminary Surveys

Site Number	Area (Acres)	Landform	Vegetation	Cultural Resources
DF-1	142	Slopes and top of a basalt-covered knoll. Bottom and edges of a playa.	Greasewood, saltbush, and ricegrass occur along edges of playa and on knoll.	Some scattered fragments of historic bottle glass.
DF-2	142	Tops of ancient lake terraces and washes in stream dissected area.	Greasewood is dominant vegetation on tops of lake terraces. Sagebrush occurs in wet bottoms of washes. Ricegrass, rabbitbrush, saltbush, cheatgrass, and Russian thistle also occur.	One isolated large, unmodified basalt flake.
DF-3	142	Floodplain at edge of lowest river terrace.	Cottonwood, silver buffaloberry, sagebrush, greasewood, saltbush, miner's lettuce and salt grass.	One prehistoric site (26Wa2680).
DF-4	142	Floodplain and river terraces.	Alfalfa and cottonwoods on floodplain. Sparse vegetation on river terraces - greasewood, saltbush, cheatgrass, and rice grass.	One prehistoric site (26Wa2681) and one historic site (26Wa2682).

Table 4-39. Cont'd.

Site Number	Area (Acres)	Landform	Vegetation	Cultural Resources
DF-5	142	Canyon, sandy flats, and small, dry lake.	Sparse vegetation - greasewood, saltbush. Ricegrass is abundant.	One prehistoric site (26WA2678).

SOURCE: DRI, 1979.

wherever local conditions are favorable as on rangelands and in the well-drained river and wash bottoms. Principal shrub species in sagebrush communities include big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus* sp.), and shadscale (*Atriplex canfertifolia*).

Wildlife species generally are found only in scattered or isolated locations where their respective habitats are available. Raptors found in the Dodge Flat area include American kestrels, red-tailed hawks, marsh hawks, and golden eagles. Passerines include horned larks, western meadowlarks, sage thrashers, common ravens, wrens and numerous species of sparrows. Gallinaceous species such as the California quail are also common.

Characteristic mammals include the Townsend ground squirrel, Great Basin kangaroo rat, desert woodrat, black-tailed jackrabbit, kit fox, bobcat and coyote. Common reptiles are the Great Basin rattlesnake, common garter snake, leopard lizard and Great Basin fence lizard. Amphibians in the area include the western toad and leopard frog.

In the riparian zones, mammalian species such as beaver, muskrat, mink, porcupine, and striped skunk can be found. Several species of waterfowl are known to utilize the river during the winter months. Bald eagles have also been reported along the river in winter (Mollini, pers. comm.).

Spanish Springs Valley - JWPCP Sludge Handling and Disposal Project

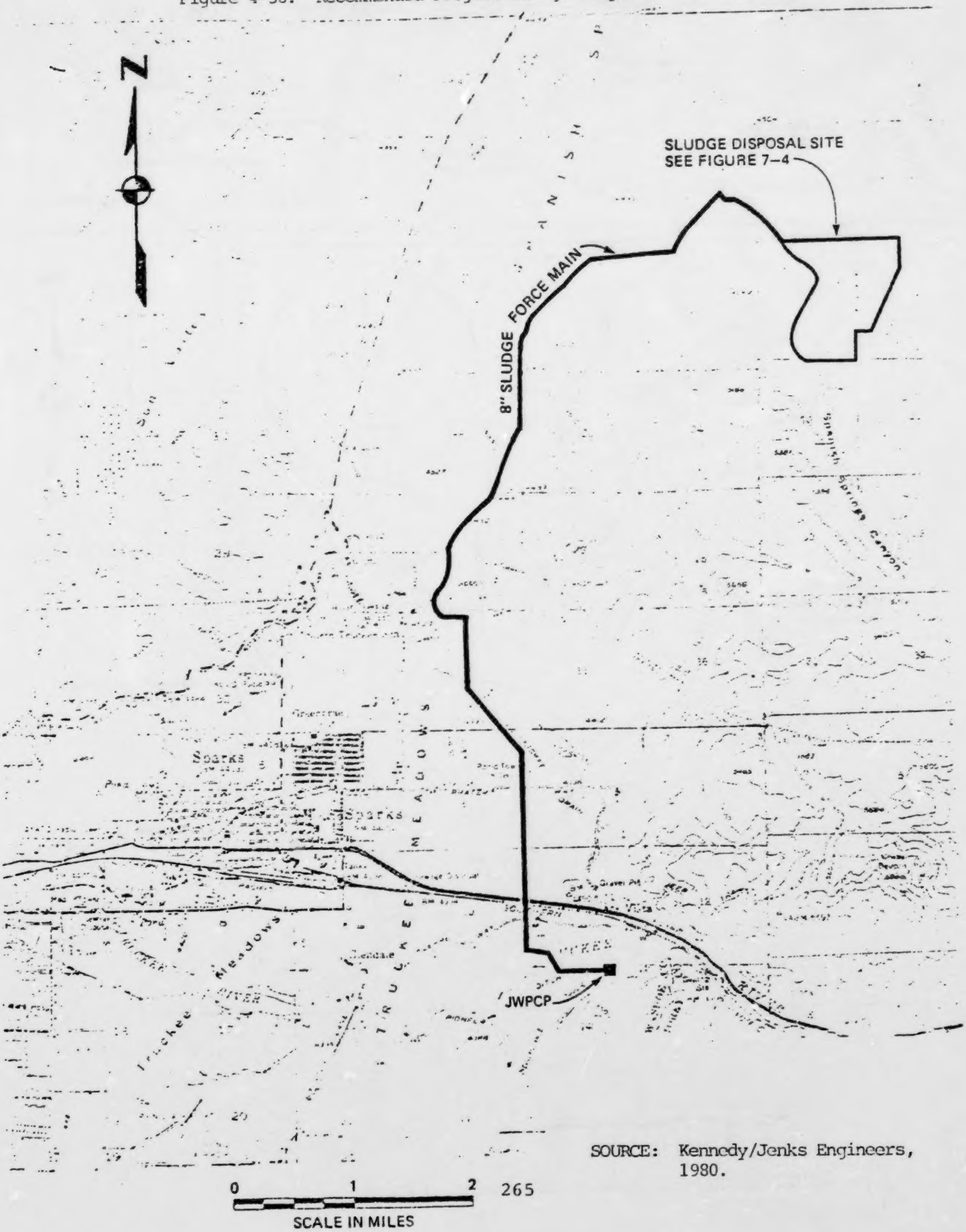
Project Location

Liquid sewage sludge will be conveyed via an 8-inch force main from the JWPCP to the disposal site in Spanish Springs Valley (Figure 4-38). The sludge will then be applied by center-pivot sprinklers to 255 acres of a 460-acre dedicated disposal site in the valley (Figure 4-39).

Climate

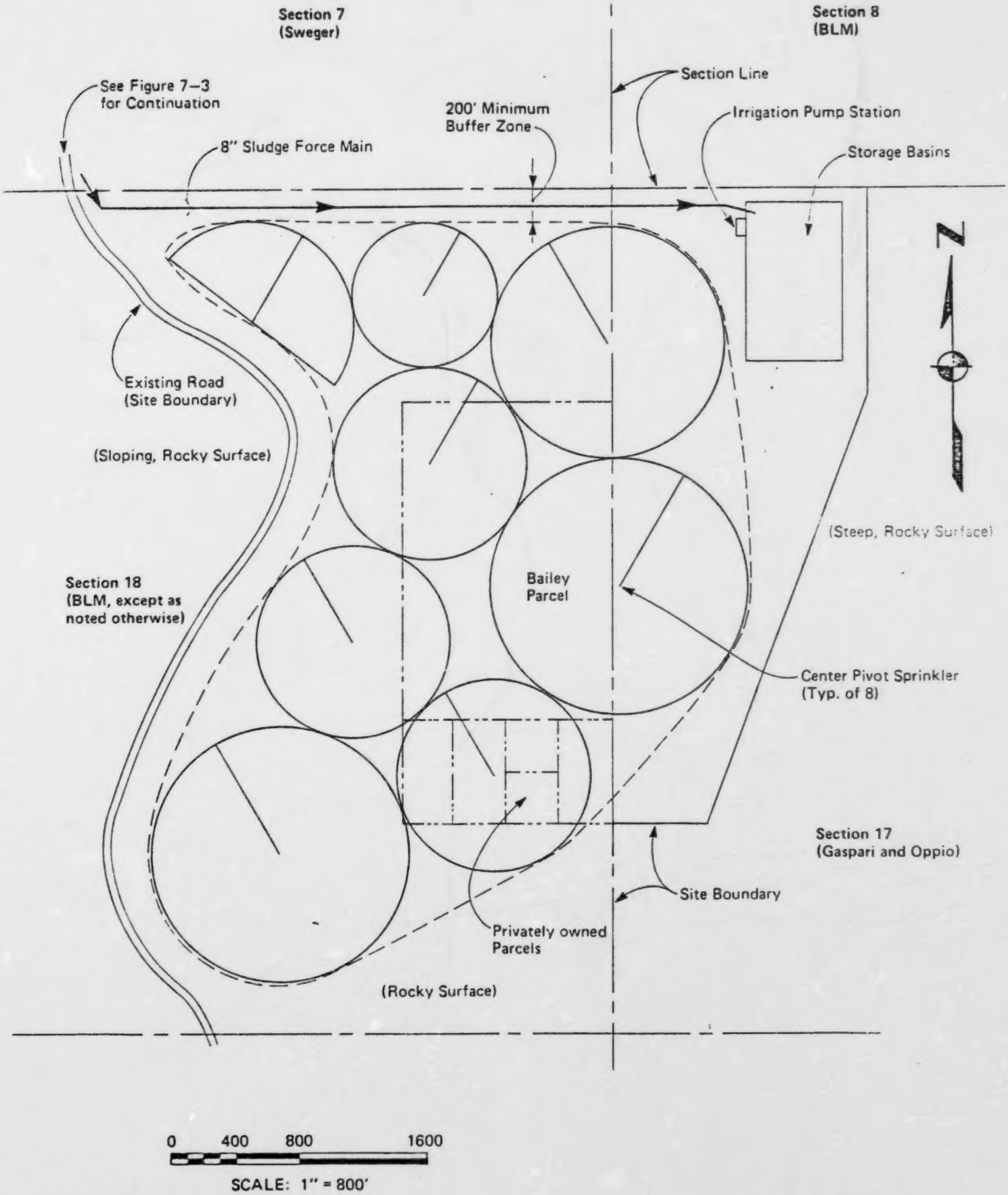
Climatic conditions will affect timing and rates of sludge application. Two factors are especially important: 1) average annual evaporation rate at Fallon is 4.75 feet (57 inches); 2) average annual precipitation at Cannon International Airport is 8 inches. Thus, the net annual evaporation rate for the disposal area is approximately 4.1 feet. Seasonal and daily rates vary considerably from the average.

Figure 4-38. Recommended Project Sludge Disposal Site Plan



SOURCE: Kennedy/Jenks Engineers, 1980.

Figure 4-39. Recommended Project Sludge Disposal Site Plan



SOURCE: Kennedy/Jenks Engineers, 1980.

Land Resources

Spanish Springs Valley, located north of Sparks, is a north-south trending valley approximately 10 miles long and 3 miles wide with an average elevation of approximately 4,500 feet. Topography of the disposal site is flat to gently sloping.

The valley is generally underlain by Quaternary alluvium and is surrounded by basalt and grandiorite. Soils of this area are generally sandy loam with permeability and water-holding capacities ranging from high to very slow. A recent soil survey identified a sloping, sandy-clay hardpan and weakly cemented subsoil underlying 20-30 inches of surface soils in the sludge disposal area. This hardpan is thought to act as a barrier between surface infiltration in the disposal area and the groundwater directly beneath the disposal site. Permeability of the soils at the disposal site was identified as being generally very slow to moderately slow (SCS, unpublished data). The sloping hardpan, while acting as a barrier to deep percolation, may also cause lateral movement of any water that infiltrates from the surface to the hardpan.

Since 1852, over 30 earthquakes of intensity VI or greater (modified Mercalli scale) have occurred in western Nevada. At least three of these were classified as intensity X, one of which was centered at Pyramid Lake. In addition, almost 2,000 other seismic shocks have been cataloged in the nearly 125 years of record. Nevada ranks among the most seismically active states (USGS, 1974). The project study area is located in a region covering western and central Nevada classified as zone 3, a zone where major destructive earthquakes may occur (USGS, 1974). Although it appears that the proposed pipeline route to Spanish Springs Valley does not cross a fault, it is located in the proximity of many faults (Nevada Bureau of Mines and Geology, 1969). A fault, which becomes concealed as it approaches the valley floor, is located along Spanish Springs Canyon.

According to a preliminary records search by the Washoe County Assessor's Office, no mining claims have been recorded or patented on the disposal site or the remainder of T20N, R2IE through November 1979.

Water Resources

The force main will cross the Truckee River and will pass 0.5-2 miles east of an agricultural drain and several ponds in Spanish Springs Valley.

Eighteen wells have been drilled in southern Spanish Springs Valley in the vicinity of Spanish Springs Canyon. The static water level ranged from 23-70 feet in depth. The coarser, more permeable materials were in most cases overlain by a relatively impermeable clay or sandy clay layer, limiting the vertical percolation of surface water to groundwater. Groundwater in this area is used primarily for domestic supplies, irrigation and livestock watering.

Biological Resources

Four plant community types occur along and in the vicinity of the pipeline route and the disposal site: 1) big sagebrush-rabbitbrush-grass, 2) mixed-desert-shrub, 3) riparian, and 4) rabbitbrush-greasewood. The first two types are the most common and widespread. Chief shrub species in the big sagebrush-rabbitbrush-grass community are big sagebrush, spiny hopsage, Nevada ephedra, littleleaf horsebrush, and antelope bitterbrush (USFS and SCS, 1972). The principal shrub species of the mixed-desert-shrub community are upland greasewood, shadscale, bud sagebrush, and rabbitbrush. Plant species in riparian communities located in the Truckee River Valley river plain, include sedges, rushes, cottonwoods, and willows. The rabbitbrush-greasewood community occurs principally on bottom lands of Spanish Springs Valley.

The majority of the Spanish Springs Valley sludge disposal site is in big sagebrush, bottlebrush squirreltail and cheat grass with smaller concentrations of Anderson peachbrush, low sagebrush, low and Douglas rabbitbrushes, spiny hopsage, green ephedra and Indian ricegrass (SCS, 1979). The area has been heavily grazed and is in poor condition. As a result, it does not support a large or diverse population of wildlife (Lorain, pers. comm.). The wetland area of Spanish Springs Valley supports a larger concentration and diversity of wildlife than the surrounding arid lands.

Great horned owls, barn owls, burrowing owls, American kestrels and red-tailed hawks are representative of raptors found in the area. Common passerine birds found in the study area include sage thrashers, horned larks, meadowlarks, swallows, ravens, jays, magpies, wrens, and numerous species of sparrows. Golden eagle and prairie falcon aeries have also been documented in the vicinity (Herron, pers. comm.). Characteristic mammals are Townsend ground squirrel, Great Basin kangaroo rat, black-tailed jackrabbit, and coyote. Common reptiles include the Great Basin rattlesnake, common garter snake, and Great Basin fence lizard (WCOG, 1978b).

A variety of game and nongame fishes identified in Appendix I occur in the Truckee River. Several species of special concern to federal and state fish and wildlife agencies are known to occur in the vicinity of the project. The Lahontan cutthroat trout (Salmo clarkii henshawi) was initially designated on the federal endangered list on October 3, 1970 but was reclassified on July 16, 1975 to threatened status. The endangered bald eagle (Haliaeetus leucocephalus) infrequently uses the wetland areas in Spanish Springs Valley and the Truckee River corridor. Endangered peregrine falcons (Falco peregrinus) migrate through the area and have been seen in Spanish Springs Valley. Species classified as protected by the State of Nevada that are known to occur in or infrequently use the study area include the merlin, snowy plover, burrowing owl, long-billed curlew, Sierra red fox, and kit fox (Herron, pers. comm.).

Cultural Resources

The pipeline will cross the previously disturbed areas in northeastern Sparks that probably do not contain meaningful cultural artifacts. On the other hand, many cultural resources are probably located in the vicinity of the pipeline route north of Sparks, based on the cultural resources reconnaissance survey conducted by the Nevada Archeological Survey in 1976 for EPA. The pipeline parallels Spanish Springs Road which borders the eastern edge of the marsh in southern Spanish Springs Valley. A nearby, continuous scatter of artifacts exists between the road and the marsh for at least 2 miles in T20N, R20E, sections 22, 15, 14, 11 and 12. Included among these artifacts were approximately 300 grinding stones. This high concentration of artifacts suggests that this area was a major winter village site and that seed processing was also an important activity here.

A cultural resources reconnaissance survey was conducted for the northern and eastern parts of the sludge disposal site in December 1979 by DRI. A survey of the southwestern portion of the disposal site is currently underway; survey results will be included in the Final EIS. The following discussion is excerpted from the report prepared by DRI on this survey.

Field reconnaissance revealed six previously unrecorded cultural resources and disclosed additional cultural remains at the location (26Wa2412) of a previously recorded isolated flake (Figure 4-40). Characteristics of each cultural resource known to occur in the study area are outlined in Table 4-40. These cultural resources, although representing only a portion of the total cultural resources in the study area, probably accurately reflect the kinds of archeological materials which may be expected to occur there.

Figure 4-40.

Map showing the location of the cultural resources disclosed during a preliminary surface reconnaissance of the proposed sludge disposal area, Spanish Springs Canyon, Washoe County, Nevada. This figure is not included, as the site-specific information may jeopardize these cultural resources.

Table 4-40. Selected Characteristics of the Cultural Resources Located During a Preliminary Surface Reconnaissance of the Reno-Sparks Sewage Effluent Sludge Disposal Area, Spanish Springs Canyon, Washoe County, Nevada

Site Number	Area (ares)*	Landform	Vegetation†	Description
26Wa2412	4.5	Alluvial Ridge	Sagebrush/Rabbitbrush	Sparse scatter of white chert, yellow jasper, basalt, and tachylyte flakes
26Wa2689	450.0	Eolian Dunes	Rabbitbrush/Sagebrush	Diffuse scatter of white, red and white, gray, and green chert, basalt, and tachylyte flakes;two basalt milling stones; and two rock features
26Wa2690	2.0	Colluvial Slope	Sagebrush	Dense (20 flakes/m^2) scatter of white chert thinning and reduction flakes
26Wa2691	160.0	Colluvial Ridge	Sagebrush/Rabbitbrush	Sparse scatter of white, red and white, and gray chert, red and yellow jasper, and basalt flakes. One basalt mano.
26Wa2692	10.0	Eolian Dunes	Rabbitbrush/Sagebrush	Sparse scatter of white chert, yellow jasper, basalt and tachylyte flakes and basalt bifacial chopper
26Wa2693	1.0	Alluvial Flat	Sagebrush	Dense (15 flakes/m^2) scatter of white chert thinning and reduction flakes
26Wa2694	1.0	Alluvial Ridge	Sagebrush	Sparse scatter (4 flakes/m^2) of white and red and white chert thinning flakes

* An are is definded as 100 m^2

† Vegetation is listed in order of dominance

Three located archeological sites, 26Wa2690, 26Wa2693 and 26Wa2694, are characterized by small (1-2 acres), dense concentrations of lithic debitage from similar raw materials. These sites probably reflect localities where aboriginal Indians shaped and resharpened stone tools. They occur on a variety of landforms supporting nearly pure sagebrush stands. The fact that flakes from only a single raw material type occur at these sites is interpreted to indicate that these loci may have been used for a single chipping activity (stone tool manufacture) of relatively short duration. No tools nor diagnostic artifacts were associated with these chipping stations.

Two archeological sites, 26Wa2412 and 26Wa2692, are typified by relatively small (4.5-10 acres), sparse scatters of flakes and flake tools made from different raw materials (chert, jasper, basalt, and tachylite). Functional interpretations of these sites are not possible with the present data base; however, they might reflect relatively short-term activities other than stone tool manufacture. However, both sites occur in geological contexts which may contain subsurface deposits bearing cultural remains and those remains observed on the surface may reflect only a portion of the actual assemblages at the sites. Laboratory analysis of cultural materials from these sites could aid in evaluating their functional meaning.

The final two archeological sites, 26Wa2689 and 26Wa2691, discovered during this preliminary reconnaissance cover relatively large (160-250 acres) areas and consist of a variety of artifacts and raw materials. Both sites contain ground stone tools. In addition, site 26Wa2689 is also characterized by two unnatural concentrations of small (10-15 cm maximum dimension), rounded basalt cobbles arranged in rounded, but irregular, patterns 2.5-3 m in diameter. These features could reflect several activities and further research is necessary to assure their specific meaning. The presence of these features, grinding slab fragments, as well as widely scattered flakes of different raw material types, are interpreted to imply that site 26Wa2689 may represent a more permanent loci of aboriginal Indian activity. This site occurs in a geological context which is extremely favorable for buried cultural remains. Site 26Wa2691, although characterized by an artifact assemblage similar to 26Wa2689, occurs on a colluvial ridge and lacks the stone features of 26Wa2689. Hence, these two sites reflect different cultural events. Further research would be necessary to assure the cultural/functional relationships between these sites. Both have the potential to yield subsurface cultural remains.

No diagnostic artifacts were recovered during the preliminary reconnaissance of the proposed sludge disposal area. Thus, it is difficult to estimate the probable time depth or cultural affiliations represented by these cultural resources. This absence of diagnostic artifacts might be a reflection of: 1) sampling error, 2) the nature of aboriginal use of the study area, or 3) intensive surface collections by vandals. Since the study site occurs in an easily accessible area adjacent to a major modern population center, the latter interpretation is preferred.

This research clearly shows that the area was used by aboriginal populations. However, it is not possible to assess the exact nature or time of this use with the present data base. It is possible at present to indicate the suspected significance of the cultural resources located during the DRI's investigations.

All sites occur on substrata which have a potential to yield buried cultural remains. However, certain sites (the chipping stations 26Wa2690, 26Wa2693 and 26Wa2694) have surface assemblages which might indicate relatively short-term aboriginal activities; whereas, the other sites have indications of either longer occupations, more diverse activities, or repeated short-term utilizations. Of this latter category, site 26Wa2689 has the best potential to yield significant subsurface cultural remains and certainly should be test excavated for this capability. On the other hand, the chipping stations (26Wa2690, 26Wa2693 and 26Wa2694) have the least potential to yield significant subsurface cultural bearing deposits. Nevertheless, this potential or lack of potential should be firmly established by further research.

Land Use, Ownership and Zoning

The sludge disposal site is partially owned by the BLM and by private landowners. Current use of the site is primarily grazing and limited recreation (e.g., hunting, off-road vehicles, sight-seeing); however, the site is neither prime grazing nor recreation land (Pope, pers. comm.). The private property located adjacent to the site in section 18 is cultivated for alfalfa. A minimum 200-foot buffer zone will be located between the sludge disposal area and this property.

The site is currently zoned for active recreation, 1 dwelling unit per 10 acres and 1 dwelling unit per 40 acres (Figure 4-41). Disposal of sludge on land zoned for 10- and 40-acre parcels would be allowed with a special use permit (McElroy, pers. comm.). Sludge disposal on land zoned for active recreation is not allowed.

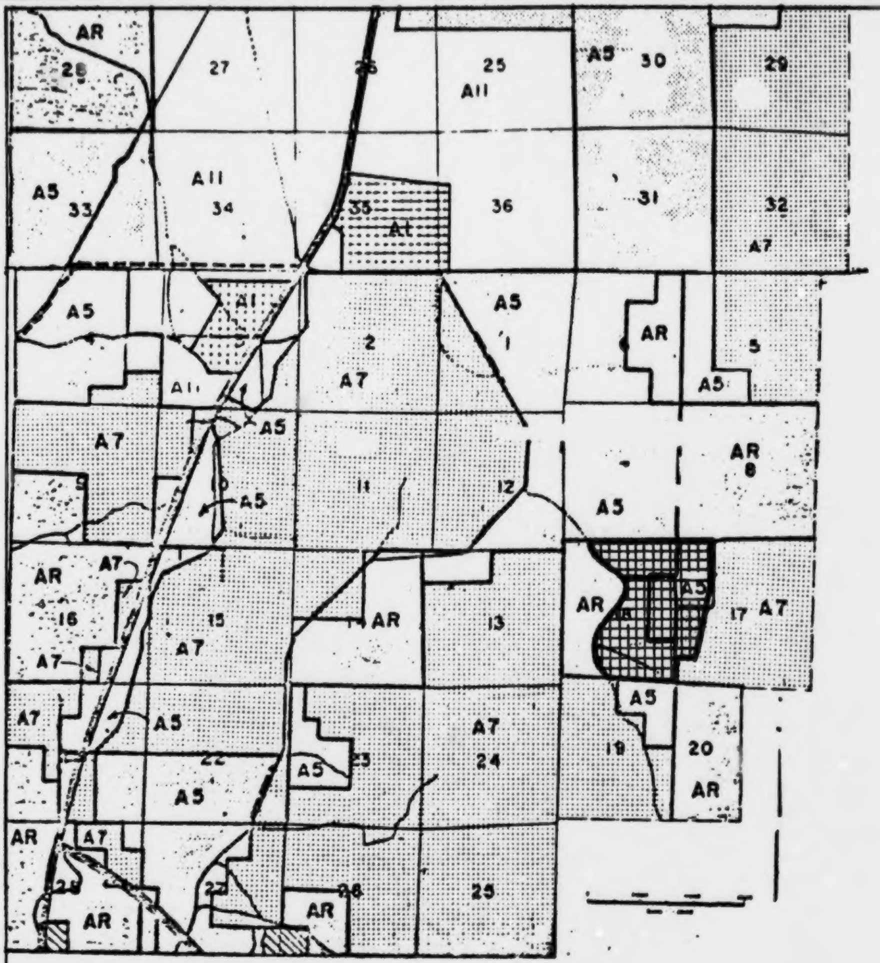


FIGURE 4-41 SPANISH SPRINGS VALLEY (District 12)
Land Use Plan

▦ SLUDGE DISPOSAL SITE

Residential

▤ RURAL ESTATES (1 DU/1 AC. OR A-1)

□ RURAL ESTATES (1 DU/10 AC'S. OR A-5)

▒ RURAL ESTATES (1 DU/40 AC'S. OR A-7)

□ RURAL ESTATES (1 DU/200 AC'S. OR A-11)

Active Recreation

⬚ (A-R)

Sparks City Limits

▨

Circulation

----- ARTERIAL

Chapter 5

ENVIRONMENTAL CONSEQUENCE OF THE MASTER PROJECT ALTERNATIVES

INTRODUCTION

The history of events preceding development of the Master Project Draft Facilities Plan (Kennedy/Jenks Engineers, 1980) and this Draft EIS is summarized in Chapter 1. Preparation of the Draft EIS has followed the so-called "piggy-back" approach, in that the environmental assessment team was involved from the start in the screening of Master Project alternatives and provided issue feed-back to the facilities plan engineer. The environmental assessment and the discussions of environmental impacts presented in this chapter have focused on interrelationships between potential Master Project actions and major issues associated with surface water quality, surface water quantity, groundwater, fish, recreation, land use and institutional arrangements. The natural resources issues are complex, not completely identified, and often only partially relatable to Master Project actions. Potential mitigation measures for significant adverse impacts are identified and discussed.

Communications between participating and interested parties has regularly occurred through monthly meetings of the Facilities Plan Technical Advisory Committee (TAC), the EIS management committee, special issue technical workshops, public meetings, correspondence, and personal contacts. A preliminary Draft EIS was issued to the TAC and the EIS management committee participants for their review and comment. The results of the many meetings and comments received on the preliminary Draft EIS have been considered in the preparation of this Draft EIS.

The scope of the Draft EIS encompasses the main treatment and disposal alternatives identified in the Draft Master Project Facilities Plan: Expansion of Reno-Sparks Joint Water Pollution Control Plan (Kennedy/Jenks Engineers, 1980) and natural and socio-economics resources potentially affected by these alternatives. It also encompasses a no-action alternative, which embodies only the 30 mgd ESP facilities. The project proposed for implementation by the Cities of Reno and Sparks, Truckee Canal Diversion (L-1), is included in the Draft EIS analysis; however, the EPA has not selected an alternative for grant funding. Therefore, the three major wastewater treatment and disposal options identified in the Facilities Plan are reported equally to the extent that data allow. The scope of the Draft EIS also includes sludge handling and disposal for both the ESP and Master Project.

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Several special considerations should be recognized relative to the content of the Draft EIS. The Draft EIS is a response to Master Project alternatives as they are described in the Draft Facilities Plan; therefore, comments on the Draft EIS are in many instances comments on the Draft Facilities Plan. These comments will be used by the EPA to ascertain and prescribe what constitutes a complete and grant fundable final Facilities Plan.

In the early stages of project development it was determined that relationships between projected population size and time, i.e., growth rate, could not be precisely established as discussed in Appendix A. Therefore, the matter of establishing a precise JWPCP treatment and disposal capacity to accommodate a 20-year planning period was moot. It was generally agreed by EPA, the cities, and the TAC that the Facilities Plan would be prepared for a 40 mgd Master Project. Numerical evaluations in the Draft EIS are based on an average monthly effluent production of 40 mgd. Small variations from the 40 mgd planning number are assumed to be within the reconnaissance level impact analysis provided in this Draft EIS. Final determination of plant capacity that will be grant fundable will be made by EPA following completion of the EIS.

Except for the scenario 406 and 288 hydrology analysis, data from existing reports were used in the water quality and aquatic effects evaluations. A calibrated and verified water quality model that can realistically project water quality was not available; consequently, evaluations are based on mass balance changes in wastewater constituent loading relative to changes in water flow. Wastewater constituent concentrations at points of discharge were calculated as a ratio of load to water flow. Evaluations of this nature provide an index to possible future conditions and not a projection of actual future conditions.

Where possible, the relative magnitudes of impacts are identified, and in many instances impacts are defined as significant. Significance is a judgment based on the relative degree of change from the existing or a standard condition. For example, an increase of 25 percent in cost of one choice over another is considered to be significant to Reno and Sparks. The degradation of water quality realized by not spending this hypothetical additional 25 percent increase in cost may also be viewed as significant. Agency responsibility, public objectives, and personal viewpoints are important considerations in weighing the significant advantages and merits of environmental "trade-offs."

The organization of this chapter focuses on the common environmental effects of the Master Project and the three primary wastewater treatment and disposal alternatives, i.e., AWT with Truckee River disposal, and secondary treatment plus phosphorus removal and filtration with Truckee Canal disposal. The impacts of no action or the 30 mgd ESP and the proposed sludge disposal project at Spanish Springs Valley follow the Master Project alternatives. Chapter 4, AFFECTED ENVIRONMENT, should be read to gain a more complete understanding of the impact analyses in Chapter 5. Additional detailed information can be found in the appendices and referenced reports and publications.

Potential mitigations for significant adverse impacts are identified to acquaint the reviewer with the generic means to lessen impacts and perhaps achieve implementation. These potential mitigations are not a part of the Facilities Plan.

SHORT-TERM CONSTRUCTION IMPACTS OF THE MASTER PROJECT

Construction of wastewater facilities typically results in an assortment of short-term nuisance impacts. This type of impact typically lasts for the duration of an activity in a particular local area. These include noise, dust, stream turbidity, and aesthetic disruptions as well as temporary access and traffic flow problems and potential safety hazards. These impacts are usually insignificant or readily mitigable to tolerable levels. When construction is complete the impact is relieved; occasionally, however, more significant impacts are created. Common short-term impacts and their mitigation measures are presented in Table 5-1. A discussion of those short-term impacts considered to be most significant follows.

Potentially significant short-term impacts associated with Truckee Canal and Dodge Flat disposal alternatives (L-1, L-6, and L-7) are related to pipeline construction and cultivation of presently noncultivated land. The proposed pipeline for Alternatives L-1, L-6, and L-7 will be buried for its entire length. Alternative L-1 crosses the Truckee River at eight locations and the Southern Pacific Railroad at three places. One additional river, railroad and I-80 highway crossing is required for Alternatives L-6 and L-7.

Railroad crossings and I-80 crossings will be constructed without disruption of traffic. A pit will be dug alongside the highway or tracks, and a steel or concrete casing forced beneath the transportation facility by hydraulic jacking and tunneling. The effluent outfall pipe would then be placed within the casing pipe.

The Truckee River crossings (Alternatives L-1, L-6 and L-7) are likely to cause temporary turbidity problems and adversely impact water quality and fisheries. The likely construction method will involve the construction of a small barrier dam with river gravels or sheet steel pilings to allow about one-half of the river bed to be protected from the stream flow. A deep trench would then be dug in this protected area, and the pipe placed and backfilled. The temporary dam would be removed, and reconstructed in the other half of the river, and the remainder of the pipe constructed. Such a crossing is normally constructed during low flow periods and may be completed within a few weeks.

The disturbance of the stream bed will suspend significant amounts of fine colloidal materials and organic matter from the river gravels. The result will be higher turbidity levels, higher suspended solids, higher BOD, lower DO and higher nutrient levels. The increased turbidity can cause fish kills, degrade fish habitat, and restrict fish passage.

Table 5-1 . Potential Short-term Impacts of Master Project Alternatives

The direct short-term impacts of this project are related to construction activities. Many are relatively minor in effect and magnitude and in most cases the adverse impact can be effectively mitigated. The impacts considered, our judgment of the relative level of effect and mitigation measures, are given in the following matrix.

	Disposal Alternatives[b]				
Short-term Impacts[a]	AWT[c] River Disposal	Truckee Canal Disposal	Dodge Flat Disposal	No Action	Recommended Mitigation Measures
Temporary loss of vegetation	1	2	2	0	Replant after construction or encourage regrowth of natural vegetation. Vegetation adjacent to pipelines should be flagged or fenced to keep vegetation destruction to a minimum. Disturbance to riparian vegetation should especially be avoided.
Disruption to wildlife	1	2	3	0	Vegetation removal should occur during late summer or fall when nesting birds are not present. Riparian vegetation should not be disturbed.
Water quality degradation	1	3	3	0	Construction activities in tributary streams or canals should be limited to low flow or no flow periods. Care should be taken not to discharge petroleum or other

					pollutants into streams. Slope stabilization and stream bed protection should be provided to reduce erosion potential.
Increased turbidity disturbance to fish life	1	3	3	0	Construction should occur during times when fish populations would be least affected.
Increased potential soil erosion and dust	2	3	3	0	Soils should be watered during construction. After construction exposed soil areas should be reseeded with native species or cover crops as soon as possible.
Disruption of through and local traffic, and increased congestion, dust and noise from construction vehicles	1	3	3	0	Barricades and flagmen should be posted as necessary to guide traffic through construction zones. Residents in areas should be notified as to location, nature and duration of construction. Construction traffic should avoid school and residential areas at all times, and minimize travel on congested roads at peak hours.
Safety hazards	1	2	2	0	Open trenches near residential areas should be covered or fenced at the end of each work day. All construction equipment should be secured against unauthorized use.

Vehicle emissions and dust from construction vehicles, and smoke from vegetation burning	2	2	2	0	All vehicles and equipment should be fitted with appropriate pollution control devices that are properly maintained. Burning of vegetation should be confined to periods of favorable meteorological conditions.
Visual impact of construction	1	2	2	0	Equipment should be stored in a designated area. All litter should be removed.
Spoil disposal	2	3	3	0	Wherever possible, disposal of spoil material from pipeline routes or other construction areas should be coordinated with other ongoing projects needing fill material.
Stockpiling and storage of spoil	1	2	3	0	All spoil material not needed for backfilling should be removed from pipeline routes or construction areas or spread over the surface and reseeded if possible. Dust abatement measures should be employed.
Increased noise	2	2	2	0	All equipment should have mufflers, properly installed and maintained. Construction activities should be limited to daylight hours.

Employment	+	+	+	0	None necessary.
Economic activity	+	+	+	0	None necessary.

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[a] Degree of Impact:

0 No change from present
1 Minor adverse impact
2 Moderate adverse ,impact
3 Major adverse impact
+ Beneficial impact

[b] Alternatives:

AWT, River Disposal - assumes that all six viable AWT alternatives (T-5, T-6a, T-9, T-12, T-14a, and T-15) will generally have the same construction-related impacts.

Truckee Canal Disposal - Alternative L-1.

Dodge Flat Disposal - Dodge Flat irrigation, rapid infiltration, Alternative L-6.

Dodge Flat irrigation, Fernley drain option, Alternative L-7.

[c] Assumes a dual outfall at 1) mouth of Steamboat Creek, about 800 feet from JWPCP and 2) Vista Reef, slightly over 2 miles from the JWPCP.

The exact nature of the river materials and a more precise description of impacts must await further design work and a more definite location of river crossings. The adverse effects of the crossing can be mitigated by minimizing stream disturbance, completing construction rapidly, and constructing at a time when fish susceptibility to turbidity would be minimal.

Short-term disturbance to wildlife, fish and other aquatic life could occur during construction through excavations, increased turbidity, sedimentation, stream diversions, and the spillage of oils or other pollutants from construction equipment. Sediments during construction inhibit or destroy silt-intolerant species and contribute to the siltation of spawning gravels; however, these are short-term effects that last until the next flushing flow. Other potential impacts include visual disturbances, stream bank erosion, loss of stream bank vegetation, and disruptions to through traffic along I-80. These impacts are generally short-term and can be avoided or substantially mitigated.

The Truckee River corridor and lower Truckee River support an important wildlife community due to the availability of water and associated riparian habitat. The diverse vegetation characteristic of riparian areas allows them to support a more concentrated and diverse wildlife population than surrounding dry areas. Riparian habitat in Nevada is relatively scarce with the Truckee River supporting one of the principal riparian corridors in the state, thus, making this area even more valuable to wildlife and their beneficial uses.

Waterfowl, including Canada geese, mallard, pintail and teal, utilize the Truckee River corridor and lower Truckee River in sufficient numbers to support sporadic hunting activities. The endangered bald eagle winters along the Truckee River corridor and the endangered peregrine falcon is a sporadic migrant through this area. Eight prairie falcon and four golden eagle aeries have also been sighted along the Truckee River corridor (Herron, pers. comm.). Of the 309 species of birds found in Nevada, approximately one-third are found in this area, indicating the exceptional species diversity and importance of the habitat. Mammals such as beaver, mink and long-tailed weasel inhabit the area. Other wildlife species primarily found in canyons surrounding the Truckee River, such as mule deer, chukar partridge, California quail and mourning dove, also make use of the riparian corridor.

Although the riparian habitat continues to support a greater diversity and population of wildlife than surrounding areas, this wildlife habitat and the supported wildlife populations have significantly declined as the Truckee River Basin is developed. Historically, the riparian habitat below

Verdi consisted of extensive groves of large cottonwoods with smaller shrubs forming dense thickets and understory consisting primarily of buffalo-berry and willow (NDW, 1975). This riparian habitat has since been reduced to a thin discontinuous ribbon of cottonwoods and shrubs along the river.

Although extensive deterioration of this habitat has occurred, it is still a very valuable wildlife area and should be protected. It is possible that this habitat will be at least partially restored in the future. The pipeline alignment down the Truckee River corridor under Alternatives L-1, L-6 and L-7 can and should be designed to ensure protection of all riparian vegetation.

The construction of a spray irrigation system, buffer zones, surface runoff controls and surface roads for Alternatives L-6 and L-7 will ultimately convert 4,130 acres of native vegetation to hay. An additional 67 acres of native vegetation will be replaced by the construction of the storage reservoir. A temporary loss of vegetation on an area of this magnitude can significantly increase wind and water-driven soil erosion. Soils in the Dodge Flat area are sand to sandy loam and when exposed are subject to erosion primarily by wind. During construction of the spray disposal and storage reservoir areas, wind erosion of soils could be controlled by sprinkling water or soil stabilizing chemicals on the soil surface. A significant amount of soil and rock would also be excavated from the storage reservoir site and used in dike construction or removed.

Permits, easements and permanent rights-of-way will be required for the disposal pipelines. The acquisition of these easements and rights-of-way may prove disruptive to some land owners, since disputes on the value of land to be acquired by the cities may need to be litigated. Construction easements, where the contractor can store materials, equipment, excavated material and otherwise conduct his work, will be acquired on a temporary basis and will temporarily disrupt the normal use of such land.

OPERATIONS IMPACTS: LONG-TERM DIRECT AND SECONDARY EFFECTS OF WASTEWATER TREATMENT AND DISPOSAL

Impacts Common to All Alternatives

Some effects of operating the 40 mgd JWPCP Master Project are essentially independent of the choice of a wastewater treatment and disposal alternative. There are two principal reasons for implementing the Master Project and both reasons support wide-ranging benefits throughout Reno-Sparks.

Reno-Sparks and surrounding areas are growing rapidly and require additional sewerage, as well as other utility services, to accommodate growth in a manner that effectively protects both natural and socio-economic resources. The quality of the Truckee River has been increasingly degraded by the discharge of treated wastewater from the JWPCP with a concomitant impairment of downstream beneficial uses. Effluent quality problems and capacity limitations have led to restrictions on residential and commercial hook-ups to the JWPCP. The use of private and community package sewerage systems to satisfy growth needs not met by the JWPCP can interfere with coordinated environmental planning for the area, and threatens valuable groundwater supplies. The Master Project, by increasing sewerage capacity to 40 mgd, and by either using advanced wastewater treatment or the reuse of wastewater for crop irrigation, will provide many benefits to Reno-Sparks, Washoe County and downstream users of the Truckee River. There are also common disadvantages and some effects which are unclassifiable. All significant common effects are discussed in this section.

Common Advantages

The Master Project will allow Reno, Sparks, and some adjacent areas to grow unimpeded by limitations of capacity to treat and dispose of sewage. The population presently being served by the JWPCP is about 155,000. New residential and commercial project development is not occurring because it is very difficult to acquire an allowable wastewater treatment and disposal opportunity, either through hook-up to the JWPCP, privately owned treatment plant, or individual systems such as septic tanks. Completion and operation of the 30 mgd ESP will relieve this impediment to growth until its capacity is reached in about 1985. At the present level of sewage generation, the ESP will accommodate a population of about 226,000. Implementation of the Master Project before the ESP reaches its design capacity can prevent sewerage from becoming a significant limiting factor in the area's economic development. The 40 mgd Master Project would then accommodate a population of about 308,000 which may occur in about 1996. If an effective urban water conservation program is implemented, as may occur through the water conservation program required by EPA as a grant condition for the ESP, the populations accommodated by the plant could be 10-30 percent greater.

In cases where sewerage capacity is not a significant factor in economic and social development, certain benefits may accrue to the community.

- o Disruptive competition for the available sewage capacity is avoided.
- o Sewage services can be provided on a prompt and equitable basis.
- o Small and potentially less effective and efficient package or satellite wastewater treatment systems can be incorporated into the Master Project.
- o Opportunities for the regional 208 planning agency to work more closely with city and county governments are enhanced.
- o The development or annexation of sewer service areas may occur in a more orderly and cost-effective manner.

All of these benefits can cause local decision making activity to focus on other problems requiring remedial action.

There are local and federal costs to be paid for in the Master Project. Although local costs vary with treatment and disposal options, there is the benefit of 75-85 percent federal funding. Considering a possible capital construction cost in excess of 50 million dollars, the federal grant stemming from Section 201 of the Clean Water Act can be a substantial local benefit. Expenditures for materials and labor will significantly affect local economics during the period of construction. Employment and the purchase of equipment, materials, and supplies will increase significantly.

All treatment and disposal options reduce the total pollutant load entering the river in comparison to current conditions. Concentrations of pollutants should be decreased compared to conditions represented in the PEL (1979) report. Considerable controversy has resulted from the discharge of increasing amounts of nitrogen and phosphorus compounds to the river. The ESP at 30 mgd will be operated to significantly reduce the phosphorus load from over 800 to less than 100 pounds per day at 24 mgd while the 40 mgd Master Project will either reduce or remove JWPCP phosphorus and nitrogen loads from the river. At average monthly river flows, the receiving water standards for total nitrogen and total phosphates of 0.75 mg/l and 0.15 mg/l, respectively, will be achieved at most average river flows. The discharge of other potential pollutants will also be reduced substantially. Whichever Master Project treatment and disposal option is finally implemented will reduce the average daily load of potential pollutants discharged to the river from the JWPCP. The reductions in certain waste loads entering the Truckee River for the three different disposal alternatives are given below. In all cases there is either significant improvement in the quality of wastewater entering the river, or the discharge to the river ceases, i.e., a 100 percent change. Generally, improvement in the quality of the river is expected with the greatest river quality benefit being derived from either land or canal disposal.

Average Effluent Load in Pounds per Day to the
Truckee River from Vista to Derby Dam with the
Master Project JWPCP

	Present JWPCP at 20 mgd	Early Start JWPCP at 30 mgd	Truckee River Disposal 40 mgd	Land Disposal 40 mgd	Truckee Canal Disposal[2] 40 mgd
BOD[1]	1,130	2,000	2,670	0	-
SS	2,755	2,000	2,670	0	-
Nitrate-N	109	250	1,300	0	-
Nitrite-N	363	375	33	0	-
Ammonia-N	2,108	4,000	167	0	-
Total N	3,059	5,380	1,670*	0	3,486
Total P	808	100	133*	0	21
TDS	25	44	83	0	2

*Annual average

[1] Carbonaceous BOD

[2] Values are seepage and spillage loads from the Truckee Canal to the lower Truckee River at 406 operations conditions. Dashes indicate estimates not developed for these constituents.

[3] Tons per day

The Master Project will significantly reduce or eliminate the influx of pollutants from the JWPCP to the Truckee River, and substantially improve compliance with water quality standards for the Truckee River. These standards have been established by the State of Nevada and are presently under review for approval by the EPA. The standards are intended to maintain and protect downstream beneficial uses of the river including fishes. Pollution of the river, including acutely toxic conditions that kill fish and other aquatic organisms, will be largely abated. Toxic conditions should not occur and nutrient enrichment that results in unacceptable growths of algae will be significantly reduced. Risks to public health will be reduced by improved effluent disinfection and effluent filtration, or complete removal of the effluent from surface and groundwater resources now being used for agriculture and domestic use.

The abatement of pollution in the Truckee River is expected to improve the public's view about the value of the river, a natural resource that offers multiple use opportunities. If the river is generally perceived as clean rather than polluted, public support for developments that fully use the instream qualities of the resource seems more realizable. An aesthetically pleasing river may generate interest in intensive recreational use of the Truckee River corridor including resorts, parks and residences attracted by fishing, rafting, swimming and other forms of recreation. Multiple use can be nonconsumptive and based on instream flow if water quality is acceptable. All of the proposed alternatives improve opportunities for recreational development, but with some differences in the quality of use. These improvements may also enhance the public willingness to implement nonpoint source programs for additional improvements of water quality.

Improvements will occur in the aquatic habitat and fishery downstream of Steamboat Creek although the magnitude of improvement would be different for each alternative. These improvements to the river are of the following nature:

- Remove toxic conditions.
- Reduce turbidity and suspended materials.
- Reduce growths on rocks and organic materials that accumulate in quiet water.
- Raise concentrations of dissolved oxygen in the water and bottom sediments.
- Produce a wider variety of aquatic insects that in turn support a greater variety of fishes.
- Improve fishing for sport fish including trout.

Filtration and improved disinfection of the effluent or removal of the effluent from the river increases the potential for use of the river as a domestic water supply.

Truckee River in Reno.

Common Disadvantages

Certain adverse effects of the JWPCP Master Project are common to all alternatives. Many of these disadvantages include growth and the secondary effects of that growth. The population increase that will be accommodated by the incremental 10 mgd of capacity is significant, amounting to nearly 77,000 persons, including associated commerce, industry and tourism facilities. These growth impacts, together with other common impacts, are addressed in this section.

Groundwater. Growth in the Truckee Meadows will exercise an increased demand for water to supply urban needs. SPPCo, as the major water purveyor, will seek to meet those demands from surface as well as groundwater. The groundwater source is most likely to be constrained to no more than present extraction levels by quality constraints. Arsenic levels appear to increase in response to heavy pumping. It is most likely that SPPCo, as well as the State of Nevada, will act to protect the quality of the groundwater and will require that pumping be maintained at a level such that deterioration will not occur.

As urban land uses replace agricultural irrigation and basin recharge decreases this safe pumping amount is likely to decrease. This will require greater dependence on surface water, with groundwater use probably phased so as to maximize groundwater pumping during times of the year when sufficient surface water is not available to SPPCo for meeting M&I uses, then using surface water totally when it is available.

Thus, growth in the Truckee Meadows is likely to decrease the annual yield of groundwater available for potable use in the Truckee Meadows. Recharge from agricultural irrigation is expected to ease, and maintenance of existing levels, believed to be related to maintenance of adequate quality, will require progressive decreases in pumping. This in turn will require increased use of surface water. Agricultural water rights theoretically can be purchased by SPPCo to increase surface water supplies. However, those rights are often restricted to certain months in the irrigation seasons, are subject to reduction in low flow years, may not have storage rights associated with them or may not be able to be stored at the proper time to enable efficient M&I use. This issue will need to be explored and resolved by SPPCo, the State of Nevada and the Cities of Reno and Sparks.

Water Supply. The secondary effects of the growth accommodated by the plant will increase water supply demands and require that a greater proportion of demands be met with surface water rather than groundwater. As more residential, commercial, and industrial growth occurs in the Truckee Meadows, water demands will increase. SPPCo is assumed to be the agency meeting those demands, drawing on ground and surface water sources.

As discussed in the section on groundwater, the yield available from this source for M&I use is expected to decrease as urban land uses replace agriculture. Recharge from agricultural irrigation is presently a major source of groundwater recharge in the Truckee Meadows. Additionally, heavy pumping of wells has led to some increases in arsenic levels in producing wells. It is projected that well production will need to be kept in relative balance with recharge in order to preserve the quality and utility of the groundwater basin for M&I use. Thus, as urbanization displaces agriculture and decreases basin recharge, the M&I yield from groundwater is likely to decrease and the balance will need to come from surface water sources.

SPPCo and other purveyors will need to obtain rights to surface water. In addition, SPPCo will probably need to obtain storage rights in upstream reservoirs so that the M&I water can be provided at times of demand. The purchase of agricultural water rights for M&I use has been occurring for several years. SPPCo points out, however, that these rights do not necessarily translate into an equivalent quantity of M&I water because of storage and timing constraints.

It is assumed that an adequate supply will be obtained. The hydrologic model results indicate that this urbanization taken as a whole for the Truckee Meadows, and assuming continued water use at 1978-1979 per capita rates, will have a small to undetectable effect on the average annual Truckee River flows.

The analyses in this EIS assume that lack of adequate water supply will not comprise a significant constraint on growth. The physical presence of a sufficient supply in close proximity to the Cities of Reno and Sparks leaves only institutional obstacles to increasing supplies to meet growth needs. Whenever institutional competitions for water develop, urban uses historically obtain adequate supplies to meet their needs. It is assumed that any institutional barriers will be resolved on behalf of the cities. If water is not obtained, however, restrictions on water availability could constitute a significant constraint on growth.

The hydrologic analysis evaluated the effects of urban growth and increased water use on Truckee River flows. These analyses showed that the expansion to 40 mgd would decrease average annual flows in the Truckee River by up to 5 percent if Orr Ditch Decree criteria are used to model agricultural diversions in the Truckee Meadows. If present practices involving larger diversions are continued, the effects of growth on Truckee River flows become negligible. The effects of urbanization are relatively small, since urban consumptive losses will gradually replace agricultural consumptive losses.

Low Q_{10} flows may decrease more, however, in response to urban demands in low flow periods. Flow decreases of up to 14 percent may occur. Additional detail on these decreases is contained in Chapter 4.

Water Conservation. Water conservation has been practiced in Reno during drought periods with some success. While the water system is largely unmetered (commercial and industrial users are now having meters installed), public response to a perceived water shortage was excellent. In the long run, voluntary conservation may serve adequately in droughts, but is unlikely to effectively reduce water use on a year-in-year-out basis. Metering of all water services, combined with financial incentives for conservation, is probably the most enforceable method for conservation, although it is costly to implement. If Reno is unable to obtain sufficient new water supplies to sustain growth at current per capita usage rates, conservation with metering may be the course of action selected by local purveyors to serve an expanding population from a constrained resource base.

EPA has imposed a grant condition on Reno and Sparks as part of the ESP to develop a water conservation program. The condition is as follows:

"8. The Grantee shall, to the maximum extent of its legal authority, develop, promote, implement, and enforce a vigorous water conservation plan and program to reduce per capita municipal water supply withdrawals from the Truckee River in the Reno area. The plan and program shall include:

"a) Documentation of past water conservation efforts and successes achieved, and

"b) An action program to continue to reduce residential and commercial water use on a per capita basis. The action program shall realize an objective by no later than the operational date of the "Early Start Project" of per capita water use equivalent to that during the 1977 drought conditions. The action program should be developed and implemented in association with Sierra Pacific Power Company, and written evidence of Sierra Pacific Power Company's commitments shall be obtained by the Grantee.

"The Grantee shall hold at least one public hearing on the water conservation plan and program prior to submittal to EPA.

"The Grantee shall submit the water conservation plan and program to EPA within 6 months from the date of acceptance of this grant offer, and shall submit quarterly reports of progress thereafter."

In response to that condition, the Cities of Reno and Sparks have submitted (May 1980) a Program for Water Conservation, Truckee Meadows area. The plan describes past efforts, details public information programs, and describes codes applying to water conservation in existing and new construction. It does not propose any new conservation actions that would alter per capita water use from the 1978-1979 levels used in the hydrologic modeling, except for the commercial and industrial water metering mandated by Nevada state law in 1978. Meter installation is scheduled for completion by SPPCo in 1981. No estimates of the effectiveness of this metering are available. Since water service is provided mainly by SPPCo, a private company, and the conservation requirement is placed on the city governments, who are not water purveyors at all, an institutional problem exists.

If this grant condition is met, per capita water use would be reduced below the levels assumed in the hydrologic analyses. However, information submitted to EPA to date does not indicate any quantitative measures of whether the condition will be met.

Water conservation would enable the 40 mgd plant to support a larger population, probably as much as 20-30 percent greater than without conservation. This occurs through reduced water use in residences, businesses, and industries, and reduced sewage treatment plant inflows. Sewage tends to become more concentrated, however, and some plant adjustments may be necessary to cope with changed waste loads while maintaining adequate effluent quality.

The total Truckee Meadows water use for the various levels of growth assumed in the model analyses in this EIS include the current use of about 46,000 acre-feet per year; 67,700 acre-feet per year, following the completion of the ESP; 101,000 acre-feet per year for the Master Project alternatives at 40 mgd; and 130,000 acre-feet per year for the upper limit population of 374,640 persons. This ultimate figure was computed assuming present (1978-1979) per capita water use and applying that to the population. It does not take into account water conservation or other measures that may reduce water use.

Land Use

The growth of the Reno-Sparks area that will be supported by the Master Project will change the use of additional areas of the Truckee Meadows. Growth will occur in response to the desire for more housing, commercial, industrial, and public land uses, and a desire of land owners and developers to derive economic benefits. The expanded sewage treatment plant will provide sewage capacity and will be one factor enabling the growth to take place.

There has been much speculation on the nature and location of additional growth. The actual changes that do occur are largely under the control of the Cities of Reno and Sparks.

Much of this development will occur on lands that have been irrigated in the past and have irrigation water rights; however, some projects have been constructed in dry areas.

Currently, the water supply situation on the Truckee River is tight. There is intense competition between uses for the available water resources. Therefore, for urban growth to continue to occur, the SPPCo and others must either find new supplies of water or utilize existing rights.

As lands are changed from agricultural to urban usage, the water right can be transferred from the land owner to the water purveyor. This right may not provide sufficient quality or appropriate timing for urban uses, but does augment the supply available to urban use. On those lands where no water right is available, conversion to urban use must be supported by water.

In the future, growth is likely to respond to the water availability constraint by showing preference to lands which have water rights. Those Truckee Meadows lands that have water rights are close to existing urban areas and the urban infrastructure, and are topographically suited for urbanization. Growth in these areas will therefore mean a reduction in irrigated agriculture.

A general plan for the Truckee Meadows was adopted in 1972. In 1978 the plan was revised and updated. This plan delineated projected areas of urban growth. The major agricultural areas estimated to remain in the year 2000 by WCOG (1978) are in Spanish Springs Valley, east of Reno, and south of Huffaker Hills. The area south of Huffaker Hills is currently being considered for development. The total amount of nonurban land in the Truckee Meadows was projected by WCOG (1978) to reduce 80 percent between 1976 and 2000, with only 4,840 nonurban acres remaining in 2000.

Land use projections developed by Jones & Stokes Associates for the hydrologic modeling analysis projected that lands irrigated with Orr Ditch Decree water rights would reduce from approximately 14,800 acres in 1979 to 2,300 acres in 2000, an 84 percent reduction. This was based upon the assumptions that growth would occur consistent with existing and proposed land use plans and that the maximum population figure of 374,640 for the Truckee Meadows (State Planning Coordinator Projection) would be achieved. The projected land use of growth can be seen in Figures 5-1 and 5-2.

For purposes of the EIS, it was decided to develop independent estimates as input to a water balance analysis of the Truckee Meadows. The projected growth and associated land use changes were based upon population trends assuming no constraints in water availability or sewage treatment capacity. These estimates were based on work by Gruen Gruen + Associates, presented in Appendix A. In this work, Gruen Gruen + Associates developed data on the proposed locations and sizes of development in the relatively near-term from interviews with local developers regarding planned and approved projects. By comparing housing capacity, household size, and population projections, it was estimated that if the indicated housing were constructed that it would meet the housing demands to about 1985.

The areas of commercial, industrial and public uses necessary to maintain an expected urban land use mix were also estimated, and located consistent with current land use plans. These areas were then mapped with the proposed housing projects, and are shown on Figure 5-2 as expected 1985 growth. Some of the shaded areas are anticipated to be sparsely developed in 1985, representing the initial development of large ranches. No attempt is made to differentiate from areas where more solid infill is expected.

For the year 2000, selected as the upper horizon for analysis purposes in the EIS, the housing stock necessary to meet the higher level state planning coordinator's population estimtes was determined. Additional commercial, industrial, and public uses were estimated to maintain a consistent urban land use mix. These uses were then plotted by filling the ranch areas to 80 percent capacity and distributing remaining uses consistent with the adopted and proposed land use plans for the Truckee Meadows. Closer-in areas, and areas within the adopted plan areas were filled first, with the remainder being allocated to flatter valley areas outside the plan area. Figure 5-2 shows the results of these assumptions graphically.

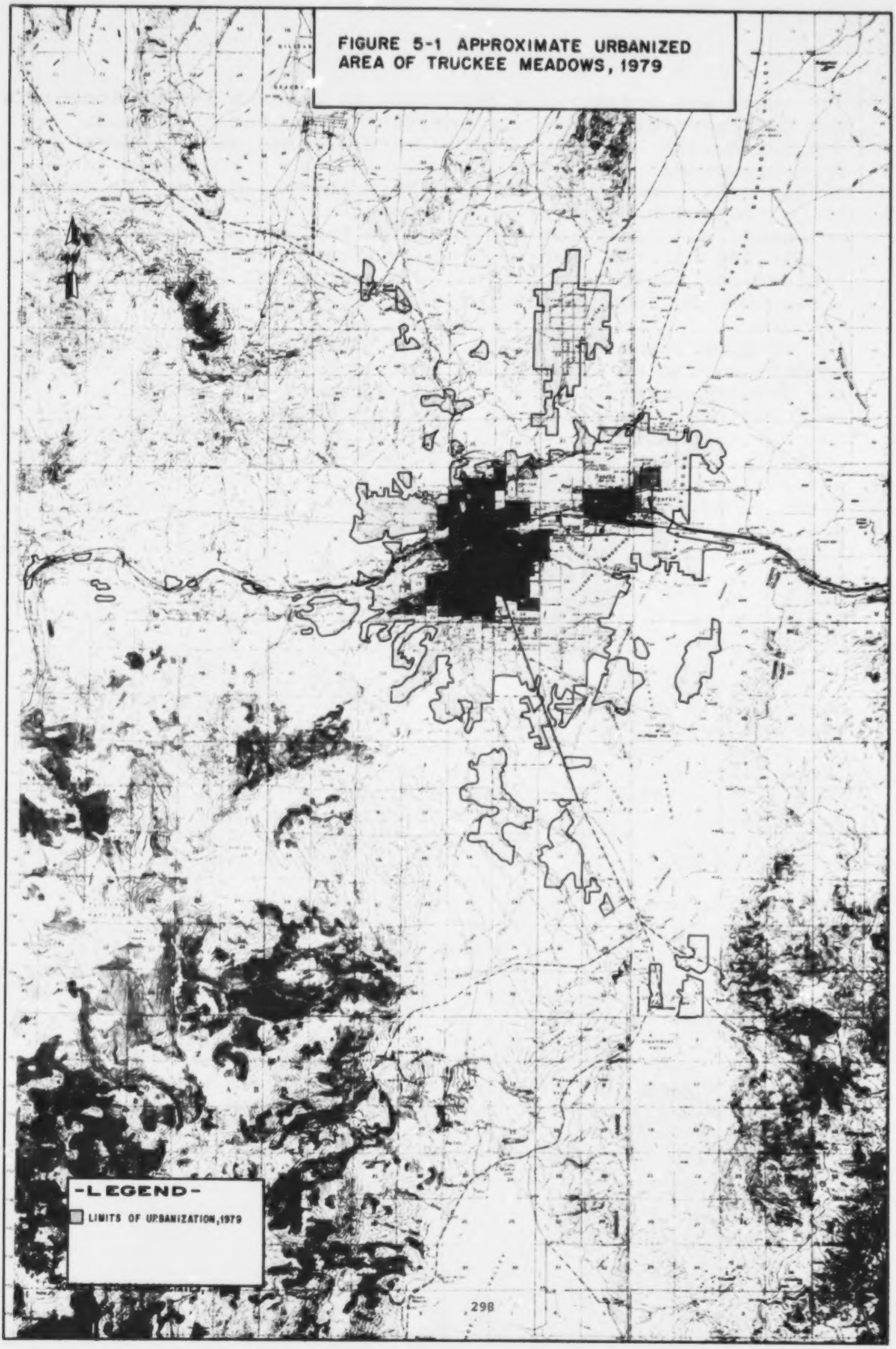

FIGURE 5-1 APPROXIMATE URBANIZED AREA OF TRUCKEE MEADOWS, 1979

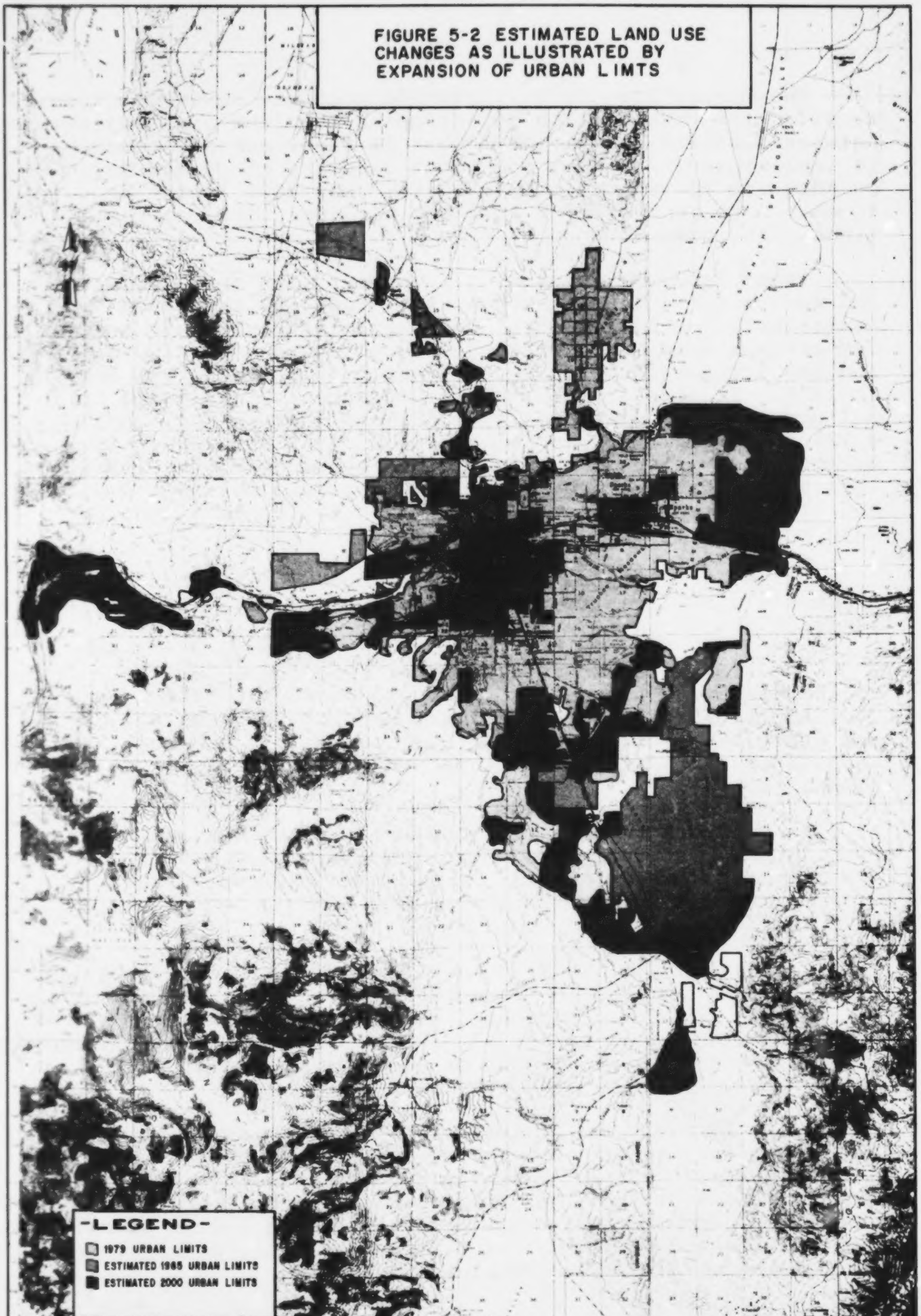

FIGURE 5-2 ESTIMATED LAND USE CHANGES AS ILLUSTRATED BY EXPANSION OF URBAN LIMTS

The Master Project will provide adequate sewerage capacity to allow for urbanization to encompass the land use projections between 1985 and about year 2000. If water conservation is implemented, however, the plant capacity of 40 mgd may be adequate to support growth to the year 2000 limits as shown. Data in Table 5-2 indicate the area that these additional land uses would occupy.

These land use changes will convert much open space and agricultural land to urban uses, reducing irrigated agriculture and agricultural water use in the Truckee Meadows. Comparisons were made between the growth shown in Figure 5-2 and the irrigated agricultural areas mapped by the URS Company in 1978. It is estimated that 5,050 acres of irrigated agriculture would be displaced by 1985, and that an additional 3,720 acres would be displaced between 1985 and 2000. If water conservation is assumed to be implemented, the irrigated agriculture displaced by the year 2000 could be about 3,720 additional acres due to the additional growth permitted by a 40 mgd plant.

Prime Agricultural Lands. The implementation of the JWPCP may allow the irreversible loss of prime agricultural lands in the Truckee Meadows.

The EIS is required to consider this issue pursuant to the directive of the U. S. Council on Environmental Quality (CEQ) stating that "highly productive farmlands" are among those "important historic cultural and natural aspects of our national heritage" which it is federal policy to preserve:

> "Efforts should be made to assure that such farmlands are not irreversibly converted to other uses unless other national interests override the importance of preservation or otherwise outweigh the environmental benefits derived from their protection" (CEQ, 1976).

Regulations of the U. S. Environmental Protection Agency (EPA, 1975) implementing the National Environmental Policy Act of 1969 require preparation of an EIS when implementation of a facilities plan may result in changes that would "adversely affect significant amounts of prime agricultural land or agricultural operations on this land".

Prime farmland is land suitable for farming or silviculture and possessing attributes established by Soil Conservation Service (SCS) of the U. S. Departmentof Agriculture (USDA): "Soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods" (Lee, 1978).

Table 5-2. Estimated Acres of Additional Urban Land Uses Supported by JWPCP Capacity Increases[1]

	Residential	Commercial	Industrial	Public
Present to 30 mgd	11,900	810	1,860	10,700
30 mgd to 40 mgd	4,600	520	1,330	4,100
30 mgd to 40 mgd with water conservation[2]	9,200	1,030	2,650	8,190

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[1] Acreages are not directly proportional to population, since initial development of large ranch areas by 1975 is assumed to be a 100 percent conversion to urban use, even though development density may only be 20 percent. See Appendix G.

[2] If water conservation is implemented and reduces per capita plant inflow by 22 percent, then full year 2000 growth as shown on Figure 5-   can occur.

Prime farmland - or, more technically, prime agricultural land - may be found in rural or in urban settings; it may be used for crops, for pasture or for other agricultural purposes; it may not even be farmed at a given point in time but may instead be in forest use or encumbered by buildings, roads or water impoundments. Basically, it includes all those lands - whatever their current uses - which have soil, climate and water availability characteristics that permit the production of "relatively more food with less erosion and with lower demand for fertilizer, energy and other resources" than nonprime land (CEQ, 1977).

On the national, state and county levels, the continuing reduction in the available supply of prime farmland has aroused growing concern about future U. S. food and fiber production.

On the national level, an irreversible loss of approximately 1 million acres per year has been experienced in recent times. Should this trend continue, the ability of the nation's agriculture to meet growing demand - the world's population is expected to increase by over 50 percent to 6 billion by the year 2000 (United Nations, 1973) - may be in doubt.

With rising world demand for U. S. food products and increasing cropland losses, policy makers have become more acutely aware of the nonrenewable nature of agricultural land. This awareness has produced a drive toward federal legislation, exemplified in the Agricultural Land Retention Act, to prevent the unnecessary and irreversible conversion of farmland to nonagricultural uses. Because of the considerable uncertainty over the future supply of productive cropland, future yields and future demand for agricultural products, there is a need to consider the costs and benefits of measures designed to preserve the prime agricultural land resources of the nation against continuing losses.

Most, if not all, of the irrigated agricultural lands in the Truckee Meadows can be considered prime farmland under the foregoing definitions. Much of the presently unirrigated acreage may also be considered prime or potentially prime, depending on availability of water for irrigation. The SCS in Reno is in the final processes of determining which lands in the study area warrant the prime agricultural land designation (McDoughal, pers. comm.). An accurate estimate of the quantity of prime agricultural land (acreage) that will be converted is impossible at this time. However, in Table 5-2 it can be seen that the ESP capacity will result in the conversion of about 25,270 acres of the land to urban use, of which 5,050 are presently irrigated.

The expansion of the plant from 30-40 mgd will enable an additional 10,550-21,070 acres to be converted to urban use, depending on whether water conservation is implemented. Of these lands 3,720 acres to 7,440 acres are in irrigated agriculture.

Thus, the JWPCP is expected to facilitate the irretrievable loss of the prime agricultural lands included in these areas.

Socio-Economic Impacts

The expanded treatment capacity of the Reno-Sparks JWPCP Master Project will allow for economic and population growth in the service area. This growth, which is the socio-economic impact of the project, will have further effects on Truckee Meadows which stem from its physical presence and its interaction with other systems. Its physical presence will include the conversion of land into urban uses - houses, shops, and warehouses or factories - and the resulting expansion or intensification of the urbanized area. Its interaction with other systems will include increased demand on water supply, potential increase in the generation of air pollutants, deterioration of water quality and additional traffic on major streets and thoroughfares. Social services such as school capacity, policy and fire protection, hospitals, social welfare, etc., will have to be increased.

These interactions may also work to limit the amount of economic and population growth that occurs. If the water supply limit is approached, or water quality problems result from groundwater overdrafts or streets become congested and auto travel difficult, growth may be expected to slow or ultimately cease.

The impacts of economic and population growth will vary, depending on whether they occur at roughly the same rate and whether enough housing is built to satisfy the demands of the increasing population. For example, if population grows at the same rate as employment (employment is a measure of economic growth) and housing construction keeps up, then (on the average) Reno workers will live in Truckee Meadows, concentrating traffic impacts on local or regional roads and contributing to the demand on water supply and wastewater treatment capacity. If, however, housing production does not keep up with the needs of the increasing population, workers' households will seek dwelling units elsewhere. As a result, commute distances will increase, transportation and air quality impacts will change, and demands on local water and wastewater systems will be displaced. Appendix A discusses in detail the economic, population, and housing growth expected in Truckee Meadows through the year 2000.

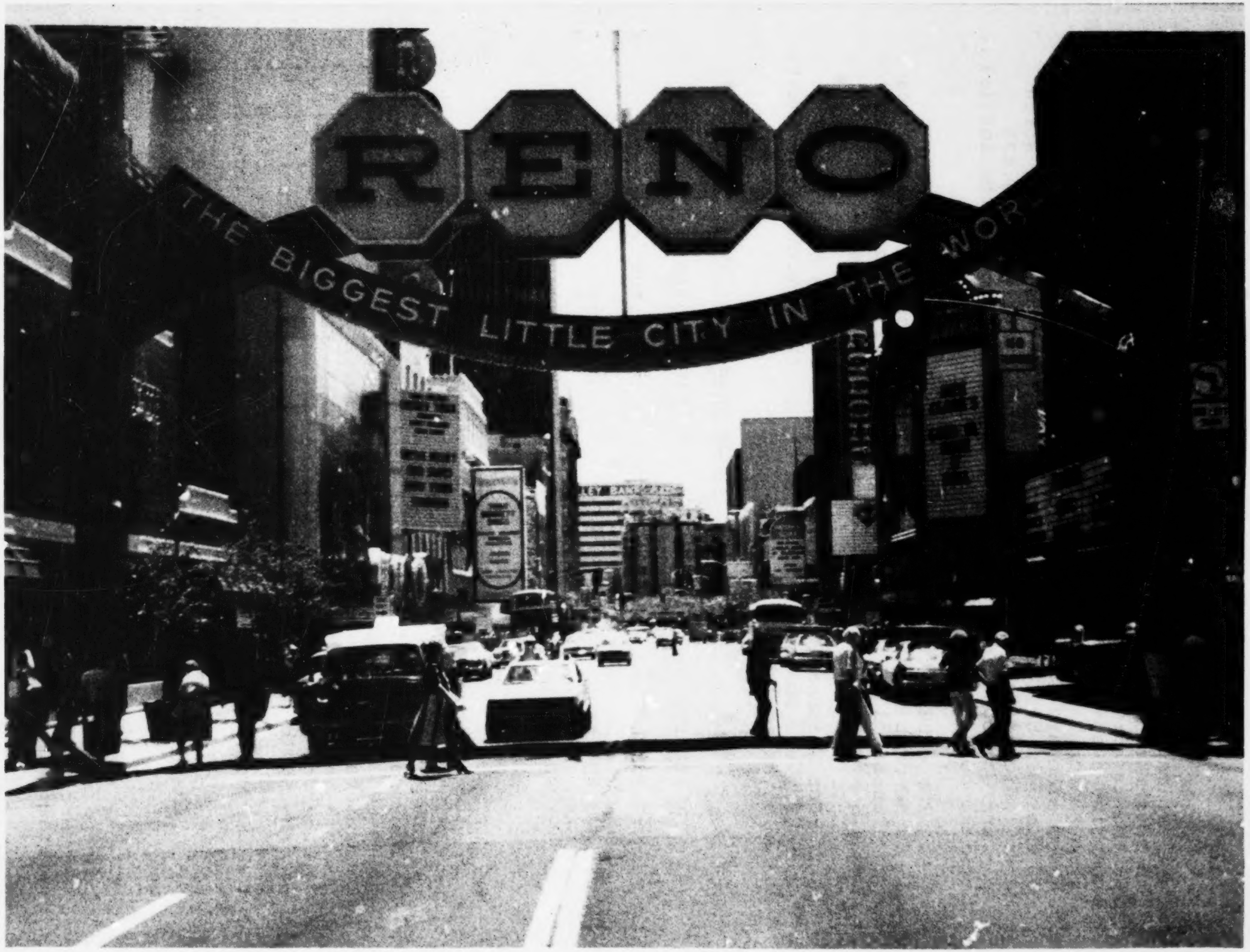
Community Services and Facilities. The impetus for the preparation of this report is a major expansion in one community facility: the wastewater treatment system. To keep pace with that expansion and the growth it will accommodate, other elements of the urban service system also must expand: the water supply, the school system, the road network and other physical systems and public services.

In another metropolitan area, it has been estimated that each thousand new residents requires 12 acres of land devoted to public education uses, parks and open spaces; 13 acres of streets; 150,000 gallons of water daily; 2 firemen and 3 policemen, as well as other facilities and services. In effect, the Master Project increases the population capacity of Reno and Sparks, and the implication is that, except where substantial excess capacity currently exists (and this is rarely the case), the capacity of all other public services must increase proportionally.

Paying for Growth. While much of the cost of the wastewater treatment project is proposed for federal funding, the cost of other public services provided locally must generally be defrayed by local funds. In theory, if the current population of about 150,000 can pay for the current facilities and services provided for them, it follows that an added 150,000 people should be able to contribute to the same degree to paying for services and facilities needed to serve them.

A number of factors suggest, however, that public facilities and services are becoming both more costly and more difficult to finance as time goes on. Among these may be mentioned the fact that interest rates (important in the financing of capital facilities) are much higher now than they were when Washoe County's current growth spurt began, meaning that it will become increasingly costly to expand the physical plant of the two cities. Further, public services in general have become more expensive over time as inflation has eroded the purchasing power of the dollar. Another factor is the relatively low wage schedule prevailing in Washoe County, which is bound to cause taxpayer resistance to increases in public costs. Finally, tax and spending limitation measures will increasingly make it difficult for local governments to expend public funds to extend essential services to growing areas.

This combination of factors raises important questions about how local jurisdictions can pay for the multitude of public services a doubling of population implies. The population growth itself poses a significant change to the region, and the provision and financing of adequate urban services to that new population is also a significant issue arising from the wastewater project.



Reno Arch.

Cost and Funding. The JWPCP Master Project alternatives are estimated to cost between $25,000,000 and $59,000,000 to construct, excluding sludge handling (Table 3-5). Annual O&M costs vary between alternatives and over the long-term comprise a significant portion of total project cost. For this reason Table 3-5 also includes a present worth estimate which accounts for the O&M expenses and expresses total cost as a single dollar value. In effect, the total present worth cost indicates the amount of money that, invested at 6.875 percent compound interest, would be required to pay the initial capital cost and the O&M for 20 years.

The alternative selected by Reno-Sparks could receive 75-85 percent funding by EPA. All but two of the alternatives are classified as innovative or alternative under EPA definition and are assumed to qualify for 85 percent funding.

For Alternative L-1, discharge to Truckee Canal, and including the costs of sludge handling, the funding requirements would be as follows:

	Funds needed in 1981-1983
Federal	$40,568,300
Reno	4,738,400
Sparks	2,739,200
Sun Valley	846,100
	$48,892,000

If the local costs are spread among a 1979 population of 150,000 in the Truckee Meadows, the per capita share of the construction cost would be about $326, minus the portion paid by business and industry. Since the City of Reno plans to issue 20-year bonds, the per capita cost including bond repayments and O&M would be about $7.65 per year, minus the portion paid by commercial and industrial users. Given an average density of three persons per household, the City of Reno would have to increase sewerage charges by about $2 per month per household to pay for all local construction and O&M costs of Alternative L-1. As the population grows, the per capita cost may decline. Other alternatives would be more costly, especially for Alternatives T-9 and T-12, for which the local share would be significantly greater due to the federal funding limitation of 75 percent.

Alternative T-9 at 75 percent funding could increase household sewerage costs by as much as $7 per month less the portion borne by business and industry. The other alternatives would be within the $2-$7 per month range.

In Reno, these additional costs could be obtained from ad valorem taxes, general revenues and sewer service charges. In Sparks, it is expected that the city will recover its local costs of project construction through sewer connection fees, both past and future. O&M charges would be funded from sewer use charges. Sparks expects that an increasing population will yield sufficient new revenue to fund O&M expenses without rate increases (Kennedy/Jenks, 1980).

Institutional Constraints

Water rights and Truckee River flows could be affected by all of the wastewater disposal alternatives proposed for the Master Project. The purpose of this discussion is to identify issues and potential mitigations for problems associated with the JWPCP alternatives. A brief discussion of on-going litigation and appropriate laws affecting water use in Nevada is presented first to aid in understanding the complexity and magnitude of water rights issues relative to the Master Project alternatives.

Nevada follows the appropriation system for surface water allocation. Appropriation is a "first come, first served" system. Originally, appropriative rights were acquired simply by diverting water and applying it to a beneficial use. The user obtained a water right to the amount of water diverted and used, with a "priority date" of the date the right was initiated. In times of shortage, those users with earlier priority dates ("senior appropriators") have superior rights to those with later priority dates ("junior appropriators"). Appropriative rights may be forfeited through nonuse or unreasonable use.

Today, most prior right appropriation states require application to a state agency for an appropriation permit in order to validate and secure a diversion and use. The date of application then becomes the priority date. In addition, most states provide for "adjudication" of water rights; when a water course is fully appropriated, water users may initiate judicial proceedings to have the quantities and priorities of all water rights holders on the water course determined, or "decreed".

Nevada Water Law. In Nevada, the system of water rights is administered by the state engineer (NRS §533.025 *et seq*.). A water appropriation, including purpose, place and period of use, and point of diversion, can be granted if there is unappropriated water in the source, if the use will not impair the value of existing vested rights, and if it will not be detrimental to the public interest (Nev. Rev. Stat. §533.70). Constraining conditions may be placed on the appropriation.

Water in Nevada may be appropriated for any beneficial use. Beneficial use is not specifically defined; it includes almost any purpose. The beneficial use is the "basis, measure, and limit of the water right; a user does not have a right to any more water than he can apply to a beneficial use" (Nev. Rev. Stat. §§533.035, 533.070). In addition, the use is limited to the reasonable need, and waste is prohibited. The water right becomes appurtenant to the land on which it is used, subject to the right to change the place of use as discussed below.

Water rights in Nevada may be bought or sold like any property rights (including condemnation using eminent domain) and water users may apply for changes in points of diversion, places of use, or purposes of use (Nev. Rev. Stat. §§533.325, 533.345). The state engineer can approve changes if they do not injure others' rights or the public interest (Nev. Rev. Stat. §533.370) and may place conditions on a granted change. The right to transfer and change water rights is important because it allows rights to be sold to new parties for different uses in different places.

Water rights in Nevada may be lost through abandonment or forfeiture (Nev. Rev. Stat. §533.060). Abandonment requires an intent to give up the water right, and some act showing nonuse. Forfeiture can occur by not exercising a water right for 5 years, though this may not apply to rights which predate the forfeiture statute.

Federal Water Law and Water Rights. Although state law governs most aspects of water allocation, in some instances federal powers or federal rights may take precedence over state water rights in the case of Indian reserved rights, non-Indian reserved rights and other rights. These federal rights, some of which are the subject of litigation on the Truckee River, could substantially affect the Master Project. Federal rights are briefly described below. The federal government has broad powers to legislate and regulate for the general welfare and has the power to obtain water rights through purchase, condemnation, legislation, regulations or other means. Examples of federal regulatory powers in the Truckee River basin follow:

Under the authority of the Commerce Clause of the U. S. Constitution, the federal government has the power to protect the navigable capacity of navigable courses, such as the Truckee River, by several means.

Federal reserved water rights apply to lands withdrawn from the public domain and reserved for a federal purpose. The U. S. Supreme Court recently stated that when the government reserves land, " . . . the government, by implication, reserves appurtenant water then unappropriated to the extent needed to accomplish the purpose of the reservation. In doing so the United States acquires a reserved water right in unappropriated water which rests on the date of the reservation and is superior to the rights of future appropriators." Several federal reserved lands are located in the Truckee River basin, including the Pyramid Lake Indian Reservation, Stillwater National Wildlife Refuge, Anaho Island National Wildlife Refuge, Fallon National Wildlife Refuge and Toiyabe National Forest.

The United States may appropriate any unappropriated water on federally-owned land for congressionally authorized uses, such as on nonreserved lands. These rights carry priority dates of the time the appropriation is actually initiated and may not adversely affect other rights holders. The federal government can also purchase or condemn water for federal programs, whether or not those programs utilize federal lands. Finally, conflicts over water rights may exist among federal agencies (i.e., USFWS and WRPS).

The Truckee River is one of the most highly litigated streams in the west. Beginning in 1902, over 20 legal actions have been taken directly and indirectly on the use of the Truckee River waters. Table 5-3 summarizes the major legal actions, including those still pending, affecting the use of the Truckee River. As shown on Table 5-3 outcomes of the pending litigations, if different from the existing operating criteria for the Truckee River, could affect the resolution of water rights problems associated with land or Truckee Canal application alternatives.

Reliability of Treatment Processes and Options During Emergencies

Generally speaking, treatment facilities are quite reliable, except in the case of biological upsets. Plant reliability is enhanced by the provision of standby equipment, such as standby pumps, motors, valves, and also by conservatism, which is built into the treatment process itself. The occasional breakdown of a process component, such as a pump or motor, is easily corrected by the use of standby equipment. Conservatism in the treatment process occurs because the treatment facility is designed to handle peak loads, and not just average annual loads. The ability of a process to be overloaded significantly beyond its design capacity also increases system reliability. Loss of a large portion of the plant facilities, such as loss of one of the aeration basins due to the need for basin maintenance or modification, could be accommodated by increasing the load on the remaining aeration basins. Little or no loss of operating efficiency

Table 5-3. Chronology of Legal Action Affecting the Truckee River

Date	Event	Description	Major Outcome or Possible Outcomes
Major Background Cases			
1915	U. S. v. Truckee River General Electric Company	U. S. filed condemnation action against predecessor of SPPCo to obtain title to the dam at Lake Tahoe to ensure adequate Newlands Project water.	1) U. S. obtained title to dam; 2) storage capacity for Lake Tahoe set at 732,000 acre-feet; 3) U. S. granted title to all water in lake above 6,229 feet elevation; 4) "Floriston Rates" set at an average flow of 500 cfs/day between March 1 and September 30, and 400 cfs/day from October 1 through the end of February, measured near Floriston, California.
July 1935	Truckee River Agreement Signed	U. S. signs agreement with TCID, Washoe County Water Conservation District, and SPPCo.	1) "Floriston Rates" modified: 300 or 350 cfs November 1 - March 31, depending on level of Lake Tahoe; 2) maximum level of 6,229.1 feet and minimum level of 6,223 feet set for Lake Tahoe; 3) "Diverted Flows" of Truckee divided: 69%-WCWCD and 31%-TCID and SPPCo, with any unused portion of WCWCD's 69% available for use by latter two; 4) Boca Reservoir authorized; 5) laid foundation for Orr Ditch final decree.
September 1944	Orr Ditch Final Decree Entered	Truckee River Agreement (binding only on signatory parties) and 1915 U. S. v. Truckee River General Electric Company decree made part of final decree.	1) U. S. granted water right (with July 2, 1902 priority) to divert 1,500 cfs of the Truckee River water at Derby Dam for irrigation; 2) U. S. granted water right (with December 8, 1859 priority) to divert 30,087 acre-feet for irrigation on Pyramid Lake Reservation; 3) Newlands Project water duty of 4.5 acre-feet/acre for benchlands and 3.5 acre feet/acre for bottomlands; 4) other defendants given water rights.
October 1964	First of Department of Interior's Pyramid Lake Task Forces Produces Recommendations	Secretary Udall adopted "Action Program for Truckee and Carson River Basins California-Nevada, "Task Force Report".	1) TCID should have minimum 406,000 acre-feet/year for diversion at Derby Dam; 2) flows to Pyramid Lake should be increased by eliminating waste and delivering all water not needed by TCID to lake; 3) tribe should be allowed to use their Orr Ditch decreed right for nonagricultural uses; 4) fish ladder should be constructed at Marble Bluff in 1976.
August 1970-filed; November 1972-decided; February 1973-order issued	Pyramid Lake Paiute Tribe of Indians v. Morton	Tribe filed suit alleging that DOT regulations for operating Truckee and Carlson Rivers allowed excess diversions from Truckee and insufficient flow to Pyramid Lake.	1) Judge Gesell of Washington, D.C., district court ordered Sec. of Interior to maximize flow into Pyramid Lake and to limit TCID's diversions to 288,129 acre-feet per year (Regulations: 38 Fed. Reg. 47, 6697-6700); 2) TCID refused to follow regulations; 3) September 1973 Sec. attempted to terminate 1926 contract with TCID for operating Newlands; 4) in 1974, TCID sued Sec. challenging termination.

Table 5-3 con't.

Date	Event	Description	Major Outcome or Possible Outcomes
Pending Actions			
May 1925	U. S. v. Alpine Land and Reservoir Company, et al.	U. S. filed suit to adjudicate water rights along Carson River to obtain definite water right for portion of Newlands Project. Feels Carson should be primary source for this project.	1) Temporary order issued in 1949, revised in 1950; 2) temporary order provided water duty of 2.92 acre-feet/acre for Newlands Project (Inconsistent with Orr Ditch Decree); 3) trial in June 1979. No final decision yet.
1955	California and Nevada begin negotiations on water allocation	California and Nevada formed commission to allocate waters of Truckee, Carson and Walker Rivers (water rights of states not adjudicated in either Orr Ditch or Alpine).	Compact ratified by two states in 1970, Congress has not ratified compact. 1) 34,000 acre-feet per year to be diverted from all sources for use in Tahoe Basin (23,000 to California, 11,000 to Nevada); 2) California allocated certain storage rights to Truckee water, including 30,000 acre-feet in Prosser Creek Reservoir; 3) Nevada to have water decreed by Orr Ditch for Pyramid Lake Reservation and all excess water not allocated to California; 4) Carson River flow divided 80 percent to Nevada and 20 percent to California; 5) explicitly recognizes nonconsumptive instream uses of water as beneficial uses.
December 1973-filed; December 1977-decided; 1978-appealed	U. S. and Pyramid Lake Paiute Tribe of Indians v. TCID, et al.	U. S. filed suit claiming Winters doctrine rights after Supreme Court declined to exercise original jurisdiction. Over 17,000 defendants involved.	Defendants contended that U. S.'s claim of a Winters right on behalf of tribe barred by res judicata effect of 1944 Orr Ditch Decree and tribe limited to agricultural water right awarded in that decree. District court held that res judicata did apply. Decision appealed to 9th circuit. No hearing or decision yet. Possible outcomes - a) operation remains as stated in Orr Ditch Decree, and the U. S. proceeds with remainder of complaint; b) reservation has water right, 1859 priority date, to enough water to preserve lower Truckee River and Pyramid Lake fishery (~385,000 acre-feet/yr) or c) quantify the reservation's right at any level supported by evidence at the trial.

Table 5-3 con't.

Date	Event	Description	Major Outcome or Possible Outcomes
March 1974	*TCID v. Secretary of the Interior and Pyramid Lake Paiute Tribe of Indians*	TCID filed suit contesting 1973 interior regulations on Newlands Project operation and secretary's right to terminate 1926 contract for TCID operation of Newlands Project.	Trial completed in October 1979 in Reno federal district court. No decision yet. Possible outcomes - a) TCID continues to divert 406,000 acre-feet/yr from Truckee River, or b) TCID diversion reduced to 288,129 acre-feet/yr; and a) TCID retains operation of Newlands Project or b) DOI retains operation of Newlands Project.
1976	*Carson-Truckee Water Conservancy District, et al., v. Andrus*	CTWCD, along with state of Nevada and SPPCo, sued Sec. of Interior to force him to allocate some of the water in Stampede Reservoir to municipal purposes in Reno-Sparks. (Water currently used mainly to maintain instream flows in Truckee to benefit fishery.)	Motions for summary judgement currently pending in Reno federal district court. Possible outcomes - a) continue operation for fisheries, no M&I use, b) CTWCD granted 22,900 acre-feet/yr for M&I use, or c) CTWCD granted some amount less than 22,900 acre-feet/yr for M&I use.
April 1979-filed	Tribe's change of use petition, Orr Ditch	Tribe petitions federal district court in Nevada to apply their Orr Ditch irrigation water right to operate Marble Bluff facility.	No action taken as of October 1979; pending in Reno federal district court. Possible outcomes - a) less than or equal to about 30,087 acre-feet/yr reaches Truckee River mouth for fisheries, depending on amount applied for irrigation, b) rights remain at 30,087 acre-feet/yr for irrigation use only.

should occur. Loss of power to the treatment facility would not decrease the ability of the plant to produce a satisfactory effluent because standby electrical generation facilities are available which would provide power for essential processes. Standby power would be available for influent pumps, aeration and other biological processes, and chlorination as a minimum.

Plant reliability in the event of a biological upset can be enhanced by the ability of subsequent processes to be overloaded. For example, in the event of an upset in the aeration basins, the gravity filter and chlorination facilities could be relied upon to remove some of the constituents normally removed by the aeration basins. In the event of an upset to biological nitrification, some additional ammonia could be removed by increasing the chlorine dose to the breakpoint. Biological denitrification, on the other hand, has no backup chemical or physical system which would provide denitrification. From an overall plant reliability standpoint, biological denitrification is probably the weakest link.

While not part of the present facilities plans, a retention basin or holding basin can provide an additional safety factor to help prevent pollution of the Truckee River during times of plant failure. Improperly treated effluent could be stored in the basin and recycled through the JWPCP, as hydraulic capacity permits, after the plant is operating again. Storage capacity can be determined as a function of the period of breakdown that should be protected against.

Package Plants

At any time when capacity in the JWPCP is not readily available to a developing area, either through lack of available plant capacity or through lack of interceptor capacity, package plants may become the most feasible way in which a growing area can be sewered. Such plants have been constructed in the Truckee Meadows when capacity was not available in the JWPCP, and may be proposed in similar conditions in the future. Furthermore, the Facilities Plan (Kennedy/Jenks, 1980) indicates that package plants with wastewater reuse will probably provide waste treatment and disposal after the 40 mgd capacity is reached. A failure to construct the Master Project expansion to 40 mgd or higher will therefore not necessarily mean a cessation of growth.

If no JWPCP expansion is approved and the ESP capacity of 30 mgd remains at that level, or if it remains at 40 mgd, additional package plants seem likely to be constructed to support future growth. In these events the growth and all of its impacts would occur as described in this chapter. The Truckee River water quality will remain as it is described in Chapter 4 following completion of the ESP. This assumes that each package plant would practice land disposal, and that return flows, salts and nutrients would not have a significant effect on water quality. Each plant and its disposal would have to be evaluated to determine its effect, however, and the cumulative effects of many plants could result in significant effects.

In general, the water balance of the Truckee Meadows as analyzed in the Dodge Flat land disposal alternative correctly models the situation presented by package plants. This is true as long as the groundwater basin is assumed to remain in balance. Some specific development proposals have involved reliance on use of agricultural water for groundwater recharge during the irrigation season, with a corresponding amount withdrawn year-round for M&I use. Sewage disposal would occur through land disposal (evaporation). This specific type of occurrence is correctly represented by the land disposal model analyses presented in Chapter 4.

It is possible that the good quality groundwater area could be adversely affected by the land discharge of package plants. Increased nitrates, chlorides and TDS could degrade the supply. These same constituents could also reach the Truckee River and increase its pollutant load, similar to the seepage and spills likely under Truckee Canal disposal and similar to the return flows from rapid infiltration at Dodge Flat (Alternative L-6).

By increasing the treatment and disposal locations for wastewater, package plants would increase the opportunities for human contact. This results in an increased public health risk. Energy use may also be greater, aesthetics degraded near the plants, and the reliability may be altered by the proliferation of treatment facilities.

Many of the adverse effects can be avoided or reduced to acceptable levels if wastewater treatment and disposal are done properly. The likelihood of significant regulatory problems is magnified by the existence of numerous plants being operated and maintained by several authorities.

EPA, in grant conditions attached to the ESP, has required a coordinated institutional review of package plants. Grant condition 10(f) states:

> "f. The Grantee shall negotiate with the City of Sparks, Washoe County, Washoe Health District, and Nevada Division of Environmental Protection to execute an agreement to impose requirements on approval of any so-called "package plants" such that approvals will not result in degradation of water quality or reduction in water quantity in the Truckee River, and will not otherwise result in adverse environmental impacts. The agreement shall provide for the phase-out of any "package plants" at such time as "Master Project" becomes operational. The Grantee shall submit the agreement to EPA within 90 days from the date of acceptance of this grant offer."

Air Quality

Growth accommodated by the Master Project has the potential to adversely impact the air quality of the Truckee Meadows air basin through increases in pollutant emissions from various sources. In order to evaluate the impact of the Master Project on air quality, the growth accommodated by the project is compared to growth accounted for in the Truckee Meadows AQIP (WCOG, 1978).

Under the Clean Air Act Amendment of 1977, the EPA is authorized to withhold, condition, or restrict any grant for construction of sewage treatment facilities if it is determined that the construction of such treatment works would create new sewage treatment capacity which may reasonably be anticipated to cause or contribute to, directly or indirectly, a larger increase in pollutant emissions than has been provided for under the applicable state implementation plan. The Truckee Meadows AQIP is the local component of the state implementation plan.

The Draft Master Project Facilities Plan (Kennedy/Jenks, 1980) identifies various population forecasts prepared for the Truckee Meadows urban area. However, the Master Project was not sized to accommodate a specific population level. Due to the design of the existing JWPCP, expansion in increments of 6 2/3 mgd is desirable from an engineering perspective. The 40 mgd figure was arrived at because of this desirable increment of expansion.

According to the Draft Facilities Plan, the Master Project will provide sewage treatment capacity for Truckee Meadows to the year 1996. At current sewage generation rates, 40 mgd (on a peak month basis or 36.5 mgd as an annual average) will accommodate approximately 281,000 residents. This composite sewage generation rate takes into account infiltration and inflow, industrial and commercial flows, and tourists. A major assumption in deriving a population level which the Master Project will accommodate is that current per capita wastewater generation factors, such as the contribution of industrial and commercial wastewater flows, will remain nearly constant. Given a 1979 population level of 150,000 and a 1996 population level of 281,000 for Truckee Meadows, the resultant compounded annual growth rate would be 3.76 percent, assuming a constant growth rate. This assumed growth rate can be used to calculate population levels for intermediate years. For example, under these assumptions, the Master Project will accommodate a population of 201,500 in the year 1987. Intermediate year population figures can be used as a comparison to the population forecast used in the Truckee Meadows AQIP.

The Truckee Meadows AQIP was based on a population forecast developed by the Bureau of Business and Economic Research (BBER), University of Nevada, Reno. The BBER population forecast was used in the AQIP to develop emissions forecasts for population-dependent source categories, which comprise the majority of source categories. Control strategies were then developed to reduce pollutant emissions to levels that will lead to attainment of NAAQS. These control measures can be viewed as mitigation measures for the BBER-forecasted level of growth in Truckee Meadows. Attainment of NAAQS is scheduled for the year 1982, or 1987 if special conditions are met. Hence, the AQIP addresses pollutant forecasts and control measures up to the year 1987.

The 1987 population used in the AQIP for the development of emissions forecasts is 206,700. The estimated Master Project 1987 level of growth (201,500) is accounted for in the AQIP, and no mitigation measures beyond these adopted as part of the AQIP are necessary. It should be noted that the Master Project-derived population forecast assumes a constant growth rate, which may be unlikely.

There is nothing at present beyond those constraints discussed in Appendix A to prevent the Cities of Reno and Sparks from growing faster than the constant growth rate might assume. The cities could grow at a growth rate of 7 percent and use up the capacity within 10 years. Such a rapid growth rate might create problems achieving the emission levels in the AQIP.

Beyond 1987, the Master Project may interfere with the maintenance of NAAQS in Truckee Meadows. For example, the Master Project-derived population forecast for 1990 is 225,100. The BBER population forecast for 1990 is 213,800 (assuming Truckee Meadows accounts for 80 percent of Washoe County's population; see Appendix A). Therefore, for the year 1990, the Master Project will accommodate a population level 5 percent greater than accounted for in the Truckee Meadows AQIP. A 5 percent difference is not necessarily significant, since emissions forecasts for population-dependent source categories are based upon emission factors which exhibit margins of error. Ambient air quality monitoring will provide the ultimate measure of whether the Master Project will interfere with the maintenance of NAAQS.

A number of factors could allow a greater Truckee Meadows population than 281,000 residents. In addition to a more rapid growth rate, water conservation could lower per capita sewage flow rates, effectively increasing the population that can be served by a 40 mgd plant. A 20 percent reduction in per capita flows could be achieved in an effective water conservation program. Package treatment plants can further expand the sewage capacity available for growth in Truckee Meadows.

In summary, if population growth remains at a 3.76 percent annual rate or below, it does not appear that the Master Project will interfere with the timely attainment of NAAQS, nor does it appear that the Master Project will interfere with the maintenance of NAAQS. However, there are no assurances that the Master Project capacity will not enable more rapid growth. If such growth is allowed, maintenance of NAAQS will be jeopardized.

Mitigation of Common Impacts

The more important adverse impacts common to the alternatives are briefly identified in this section, and potential mitigation measures are discussed. The mitigation measures represent practical, identified courses of action that can be followed to lessen or eliminate adverse impacts. It is expected that EPA may consider some of these mitigation measures to be a necessary prerequisite to project funding. As such, they may be incorporated as part of the JWPCP or implemented separately by the Cities of Reno and Sparks.

Many of the impacts common to each alternative are growth related. Most of these growth-related impacts, such as increased traffic, crowding, and loss of open space, are not presented as individual impacts followed by mitigations in this section. Mitigation for these impacts is the responsibility of the cities, Washoe County and the WCOG, and is part of proper growth management planning. Only those impacts of growth which relate more directly to the JWPCP expansion, particularly those relating to water resources, are separately addressed.

- Potential for water shortages due to increased water demands from growth

  Shortages can be prevented by the water purveyor, SPPCo, acquiring sufficient water rights and managing ground and surface waters in a conjunctive way. SPPCo may also need to acquire upstream storage rights to ensure that the water will be available when needed. These steps are all costly and institutionally difficult.

  Shortages can also be mitigated through conservation. The most effective way to enforce conservation is through metering of all water use, combined with usage rates that impose economic penalties on heavy use. Rates that allow a certain base water usage at low rates, with increasing per unit costs as usage rises, are an effective incentive for conservation. Metering of residences would require a change in state law.

  Other conservation techniques can include the public education and mandated water conservation features of the City of Reno's draft conservation program, and can also include retrofit of water saving devices, use of drought-tolerant vegetation, and many other proven techniques. It should be noted that effective conservation will allow a given JWPCP Master

Project capacity to serve a larger population with conservation than without.

- Decreased groundwater yield due to reduced recharge from agricultural irrigation displaced by urban growth

  This impact could be partly mitigated through a groundwater recharge program. Surface water could be diverted from the Truckee River and percolated to the groundwater in pervious basins overlying the good quality groundwater area. This recharge could occur when water is available, and then can be pumped from wells when surface water in the river is not available in sufficient quantity to meet demand.

  The decreased groundwater yield can also be offset by reduced pumping and increased reliance on surface water, together with conservation, as previously described. Close monitoring of water levels, quality and pumping will be needed to protect the water supply.

- Potential small decreases in Truckee River flows due to growth

  The slight decreases in annual and low Q_{10} flow that could occur due to growth could be mitigated by reducing consumptive losses in the basin and by revising river management criteria. Reduction of consumptive losses could occur through more efficient diversion, conveyance and application of irrigation water, particularly where quality problems preclude reuse of percolated agricultural water. Reduction of consumptive losses can also occur through urban conservation, storage of water in reservoirs in the areas of lowest evaporation potential, minimizing the surface area of stored water, and reduction of diversions.

  Revising river management criteria could enable storage of more water to augment low flow periods. The rules and regulations that govern Truckee River flow are complex. Many institutions would be involved in any such change, and agreement would be difficult to reach.

- Package plants may be constructed, with potential direct impacts and growth inducement

  Tight management of sewage disposal by local agencies can prevent or successfully mitigate such impacts.

Local agencies can adopt requirements that allow no package plants unless it can be demonstrated that direct adverse impacts are mitigated and that growth impacts, including those on water supply and air quality, are also successfully mitigated. Enforcement of the ESP grant condition 10(f), which establishes a review committee to approve package plants, would also help prevent adverse impacts.

- Air quality may be degraded and progress toward attaining standards impaired

  Local growth management and air quality management planning can mitigate these impacts. Stricter controls and/or slower growth may be needed to successfully mitigate this impact.

- Plant failure could pose a serious threat to water quality

  Failures can be minimized by providing backup power systems, installing inplant warning systems, and providing a storage lagoon on-site. Constant effluent monitoring may be required.

Impacts of Effluent Disposal to the Truckee River (Alternatives T-5, 6a, 9, 12, 14a, 15)

The facilities needed to implement the Truckee River disposal option include an expansion of the 30 mgd ESP, which includes secondary treatment, phosphorus removal, and dechlorination, to an average peak month flow capacity of 40 mgd. A nitrogen removal treatment process and effluent filtration would be added as part of the 40 mgd Master Project. The Steamboat Creek outfall location would be moved to two new locations in the Truckee River downstream of the JWPC. Sludge would be piped to Spanish Springs Valley and disposed of by spreading on the land.

Direct discharge of AWT effluent to the Truckee River has certain beneficial and adverse effects. All Master Project alternatives would improve water quality conditions in the Truckee River and provide other common benefits described previously. The exact nature and magnitude of advantages are specific to the alternative in many instances. The particular advantages associated with the Truckee River disposal options are:

- Continued discharge of the JWPCP effluent to the river does not directly alter river flow or impair the security of downstream water rights.

- Except for the land required to construct two new outfall facilities, this alternative does not use additional private or public lands for wastewater treatment and disposal.

- A monetary benefit is gained by using the wastewater assimilative capacity of the Truckee River system to treat waste products in lieu of wastewater treatment costs. Boundary definitions for the waste assimilative capacity are the state water quality standards.

- Except for the NPDES permit issued by the NDEP so that the JWPCP meets the state's water quality standards, there is a minimum of contractional, regulatory or policy involvement by other entities.

The river disposal option will achieve incremental benefits that remedy or lessen several environmental problems associated with present circumstances.

- The Truckee River downstream of Steamboat Creek will generally achieve water quality standards designed to protect and maintain beneficial uses including the threatened and endangered fish.

- Periphyton and associated biological communities will be reduced in size.

- Concentrations of DO in sediments will increase and DO minimums will be lessened in magnitude.

- Acute toxicity in the vicinity of the outfall will likely be completely abated.

- Acute and chronic toxicity associated with unionized ammonia, nitrite, and nitrate will be abated.

- Risks of contamination and infection of humans will be reduced by improved disinfection and effluent filtration.

- The two-location point of discharge is designed to mitigate outfall effects.

These general benefits should be evaluated relative to the nature of project disadvantages described in the following section.

The disadvantages, or adverse impacts, encompass water quality effects in the Truckee and Carson River basins, effects on fish, groundwater, water supply, public health, aesthetics, institutional considerations, air quality, and energy. These effects are discussed in turn in this section, with major emphasis on water quality.

Surface Water Hydrology

The continuation of direct discharge to the Truckee River would have no effect on surface water hydrology, except as may occur due to the growth supported by expansion of the 30 mgd ESP JWPCP to the 40 mgd Master Project. The potential flow reduction from growth (0-5 percent depending on assumptions) is described in a preceding section on impacts common to all alternatives.

Water Quality

The adverse effects of AWT disposal to the Truckee River on water quality are described as follows:

- TDS levels and total salt loading will increase in the Truckee River and Truckee Canal due to AWT.
- Except for nitrogen, nutrients will still remain in the Truckee River at slightly higher than ESP levels.
- Total phosphorus and total nitrogen standards for the Truckee River may be exceeded at times due to JWPCP discharge.
- Algal growth potential in the Truckee River and Truckee Canal will be much less than present conditions, but will be slightly increased over ESP conditions.
- A maximum temperature rise of 2.3°C is predicted at the outfall due to JWPCP discharge, if effluent is discharged at maximum recommended temperature.
- Oxygen demanding substances will continue to be discharged but with a lower total oxygen demand, benefitting DO levels.
- Increased salt loads may lead to decreased irrigation efficiencies and slightly greater agricultural water demands.
- Soil salinity problems in the Carson Division of the Newlands Project would be aggravated by increased TDS levels.
- Algal growth potential in the Truckee River between Derby Dam and Pyramid Lake should be reduced below present levels, but increased slightly above ESP levels.

- Pollutants from the JWPCP will continue to enter Pyramid Lake.

- Additional nitrogen from the JWPCP may stimulate algal blooms in Pyramid Lake, degrading beneficial uses.

- Additional nitrogen from the JWPCP may stimulate algal blooms in Lahontan Reservoir, degrading beneficial uses.

Truckee River

The reach of the Truckee River above the confluence of Steamboat Creek is not directly influenced by the JWPCP Master Project, although the Truckee River above and below the JWPCP is influenced by wasteloading in California. Secondary impacts due to urbanization will also affect quality in this upstream reach. If nutrient loading to the river above Stateline increases in response to urban growth and the relaxation of effluent and river standards, Reno's and Sparks' ability to meet water quality standards at Lockwood may be impaired.

As growth occurs, urban runoff will increase without restrictive nonpoint source control programs and will adversely affect water quality. The majority of urban runoff enters the Truckee River from Steamboat Creek and north Truckee drain. The degradation of water quality by urban runoff will be offset to some extent by future reductions in agricultural return flows that occur as urban land uses replace irrigated agriculture. Urban storm runoff, agricultural runoff, and other nonpoint source pollutants are being addressed through local Section 208 planning. The local planning entity (WCOG) is confident that efforts to control nonpoint source pollutants will be successful in reducing background pollutant loads in the Truckee River. The sources of this pollution are briefly described in Chapter 4, together with proposed control strategies.

The future water quality of the Truckee River following completion of a 40 mgd JWPCP was projected primarily by utilizing data reported by PEL (1979). These water quality data characterize background conditions of the Truckee River and provide the basis for the calculation of base loads of various pollutants (Tables 5-4 and 5-5). Nitrogen and phosphorus are emphasized because nutrient loading is an important issue. It is assumed that acutely toxic conditions should not occur with the 40 mgd Master Project based on the design controls in the NPDES permit. Base loads were calculated by multiplying concentrations measured by PEL times flow. Calculated base loads of the Truckee River include agricultural return flows and urban runoff.

The Truckee River background pollutant load computed from PEL data is shown in Table 5-6.

PEL data are considered to represent the high end of a range of representative average total nitrogen concentrations. The PEL sampling occurred during the drought period of 1977-1978. These pollutant loads estimated from these concentrations were used in the quality projections to present a "worst case" situation.

It should be noted that the pollutant loads estimated in Table 5-6 were calculated assuming that there are no changes in background loads that reflect increased urbanization, decreased agricultural runoff, and/or nonpoint source controls. Insufficient data exist to quantify the effectiveness of proposed control measures and expected changes in loading due to urbanization. Also, many proposed control measures have not been implemented, and until implemented and monitored, their effectiveness is somewhat speculative. For these reasons, no upward or downward changes in background pollutant loads are incorporated in the analyses.

The projected nutrient loading for both total nitrogen and total phosphorus at 40 mgd (Tables 5-4 and 5-5) is less than the present loads measured by PEL below the confluence (45 percent less for total nitrogen, 80 percent less for total phosphorus).

Using the river disposal option, the JWPCP effluent will be discharged to outfall diffusers to the river where it will mix with the background load. Assuming complete mixing, expected concentrations of several wastewater constituents were calculated (Table 5-7). Higher concentrations are projected from late summer to spring due in part to lower dilution flows. Concentrations in the river for the average monthly flow condition appear to be relatively independent of reservoir operating criteria.

Several factors influence the concentrations shown in Table 5-7. For example, Table 5-7 is based upon the assumption of a constant pollutant flux below the JWPCP outfall. In reality, the pollutant load varies. Considering that the average load is an average for the year and that the months where the highest concentrations occur are the lowest flows, the high concentrations in Table 5-7 may represent a slight overestimation. The average annual loading should be valid, and the high flow months may represent a slight underestimation. However, variations due to these factors do not override the usefulness of data in the table.

Table 5-4. Existing and Projected Annual Average Total Nitrogen Loading to Surface Waters (lbs/day)

	Existing[1] Conditions	No Project (ESP 30 mgd)		Master Project-40 mgd					
				Truckee River		Land Disposal		Truckee Canal	
		288	406	288	406	288	406	288	406
Truckee River (Vista)									
Background	3,283	3,283	3,283	3,283	3,283	3,283	3,283	3,283	3,283
JWPCP	3,059	5,380	5,380	1,670	1,670				
Total	6,342	8,663	8,663	4,953	4,953	3,283	3,283	3,283	3,283
Truckee Canal (Head)									
Background	1,459	567	1,278	555	1,285	608	608	304	1,092
JWPCP	1,360	930	2,095	282	654			7,193	7,193
Total	2,819	1,497	3,373	838	1,940	608	1,356	7,497	8,285
Truckee Canal (terminus)									
Background	1,008	270	827	272	800	283	742	188	664
JWPCP	939	440	1,356	138	407			3,732	4,373
Total	1,947	710	2,183	410	1,208	283	742	3,890	5,037
Truckee River Below Derby Dam									
Background	1,757	2,650	1,939	2,660	1,931	2,608	1,860	2,913	2,124
JWPCP	1,638	4,343	3,178	1,353	983				
Total	3,395	6,993	5,117	4,014	2,914	2,608	1,860	2,913	2,124
Lower Truckee River[2]									
Background	1,957	2,770	2,120	2,781	2,113	2,739	2,055	2,976	2,300
JWPCP	1,824	4,540	3,473	1,415	1,074			1,496[3]	1,156[3]
Total	3,781	7,310	5,593	4,197	3,188	2,739	2,055	4,472	3,456

[1] Base case, using current loading and present flow regime.

[2] Considered to be at a point after accretions from the Truckee Canal have entered the river, but before diversions from this section of river have occurred. Assumes no return flow from Dodge Flat.

[3] This load considered to be the percentage of the JWPCP load that accretes from the canal.

SOURCE:

Table 5-5. Existing and Projected Annual Average Total Phosphate Loading to Surface Waters (lbs/day-P)

	Existing Conditions[1]	No Project (ESP-30 mgd)		Master Project-40 mgd					
				Truckee River		Land Disposal		Truckee Canal	
		288	406	288	406	288	406	288	406
Truckee River (Vista)									
Background	137	137	137	137	137	137	137	137	137
JWPCP	808	100	100	133	133				
Total	945	237	237	270	270	137	137	137	137
Truckee Canal (Head)									
Background	63	24	53	24	56	26	58	14	47
JWPCP	374	17	39	23	54			133	133
Total	437	41	92	47	110	26	58	147	180
Truckee Canal (terminus)									
Background	68	11	35	12	36	12	32	7	28
JWPCP	400	8	25	11	35			69	81
Total	468	19	60	23	71	12	32	76	109
Truckee River Below Derby Dam									
Background	76	110	81	118	84	113	82	126	92
JWPCP	450	81	59	114	81				
Total	526	191	140	232	165	113	82	126	92
Lower Truckee River[2]									
Background	85	116	88	123	92	119	90	129	99
JWPCP	502	84	65	119	88			27[3]	21[3]
Total	587	200	153	242	180	119	90	156	120

[1] Base case using current loading and flow regime.

[2] Considered to be a point after accretion from the canal has entered but before diversions from this reach. Assumes no return flow from Dodge Flat.

[3] This load considered to be the percentage of the total accretion that is occupied by the JWPCP.

Table 5-6. Projected Average Annual Pollutant Loading at the Confluence of the Truckee River and the JWPCP Outfall[4], for River Discharge of 40 mgd (lbs/day[1])

	Truckee River Background Load[2]	Average Annual JWPCP[3]	Truckee River Below Outfall
Nitrate-N	556	1,300	1,856
Nitrite-N	25	33	58
Ammonia-N	146	167	313
Organic Nitrogen-N	2,585	160	2,745
Total Nitrogen-N	3,283	1,670	4,953
Total Phosphate-P	137	133	270
Orthophosphate-P	72	133	204
Chloride	19,688	13,300	32,988
TDS	120	83	203
BOD	3,328	2,700	6,028

[1] Except TDS which is tons/day.

[2] Measured load in the Truckee River and Steamboat Creek above the JWPCP.

[3] From PEL (1979).

[4] Based on average annual recommended discharge limitations. Individual winter loading of N and P can be 50 percent higher.

DATA SOURCE: PEL, 1979; Kennedy/Jenks, 1980.

Table 5-7. Estimated Average Monthly Concentrations of Various Pollutants at the JWPCP Effluent/Truckee River Confluence at Mean Monthly Flows, 40 mgd River Disposal (mg/l)

	River Disposal, 406 Criteria												Average Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Nitrate Nitrogen (NO_3-N)	.57	.58	.42	.29	.19	.24	.65	.76	.66	.69	.76	.69	.54
Nitrite Nitrogen (NO_2-N)	.02	.02	.01	.01	.01	.01	.02	.02	.02	.02	.02	.02	.02
Ammonia Nitrogen (NH_4^+-N)	.10	.10	.07	.05	.03	.04	.11	.13	.11	.12	.13	.12	.09
Organic Nitrogen	.84	.86	.63	.43	.28	.35	.96	1.13	.97	1.02	1.13	1.01	.80
Total Nitrogen	1.51	1.56	1.13	.77	.51	.64	1.74	2.04	1.75	1.84	2.04	1.83	1.45
Orthophosphate Phosphorus (O-PO_4-P)	.06	.06	.05	.03	.02	.03	.07	.08	.07	.08	.08	.08	.06
Total Phosphorus	.08	.09	.06	.04	.03	.03	.09	.11	.10	.10	.11	.10	.08
Chloride	10.04	10.39	7.55	5.15	3.42	4.24	11.56	13.56	11.67	12.26	13.56	12.18	9.63
Total Dissolved Solids	120	120	100	60	40	60	140	160	140	160	160	140	117
Biochemical Oxygen Demand	1.84	1.90	1.38	.94	.62	.77	2.11	2.48	2.13	2.24	2.48	2.23	1.76

	River Disposal, 288 Criteria												Average Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Nitrate Nitrogen (NO_3-N)	.57	.58	.39	.25	.19	.24	.62	.87	.86	.85	.77	.70	.57
Nitrite Nitrogen (NO_2-N),	.02	.02	.01	.01	.01	.01	.02	.03	.03	.03	.02	.02	[illegible]
Ammonia Nitrogen (NH_4^+-N)	.10	.10	.07	.04	.03	.04	.10	.15	.14	.14	.13	.12	[illegible]
Organic Nitrogen	.85	.86	.57	.37	.28	.35	.91	1.29	1.27	1.25	1.14	1.03	.85
Total Nitrogen	1.53	1.55	1.04	.66	.50	.64	1.64	2.33	2.30	2.26	2.06	1.86	1.54
Orthophosphate Phosphorus (O-PO_4-P)	.06	.06	.04	.03	.02	.03	.07	.09	.09	.09	.08	.08	.06
Total Phosphorus	.08	.08	.06	.04	.03	.03	.09	.13	.12	.12	.11	.10	.08
Chloride	10.17	10.30	6.90	4.40	3.34	4.26	10.95	15.52	15.24	15.06	13.69	12.42	9.34
Total Dissolved Solids	120	120	80	60	40	60	140	190	180	180	160	160	125
Biochemical Oxygen Demand	1.86	1.88	1.26	.80	.61	.78	2.00	2.84	2.79	2.05	2.50	2.27	1.86

DATA SOURCE: PEL, 1979; Jones & Stokes Associates and DRI, 1980; Kennedy/Jenks, 1980.

A comparison of average annual concentration values in Table 5-5 with the river quality standards for Lockwood indicate that the total phosphorus standard may, on the average, be slightly exceeded and total nitrogen may be exceeded by a factor of 2. The total nitrogen exceedence is a function of the JWPCP load, the background load, and the simulated flows at Vista. Under this analysis, the JWPCP total nitrogen load will require a flow of about 400 cfs to dilute it to meet the state river standard of 0.75 mg/l. The effluent recommendations for total nitrogen at the JWPCP are for an annual average of 5.0 mg/l. In any one month the effluent quality can vary above or below this 5 mg/l figure. Such variations will change the total load present and change the probability of achieving standards.

Toxicity should be reduced with Truckee River disposal. With the 97 percent reduction in ammonia projected by PEL, the potential for ammonia toxicity is greatly reduced. Although the JWPCP nitrate load will increase, the nitrate toxicity standard should not be exceeded in the low Q_{10} flow condition in this reach. The same is true for the nitrite toxicity standard.

The toxicity standards for unionized ammonia, nitrite, and nitrate (Table 5-8) were designed to apply during a low flow condition. The PEL data were collected during such a period.

If data from Table 5-6 are compared against the projected 1-in-10-year low mean monthly flows (low Q_{10} flows), the concentrations of these toxicants can be calculated. The highest pH and temperature below the outfall, as measured by PEL, were used to compute the unionized ammonia concentration. Temperature data collected by DRI in Reno were used for the October, November, and December estimates.

The results of this analysis are shown in Table 5-8. Only the months where potential problems exist were included. The remaining months had higher flows and therefore lower concentration than those shown in Table 5-8.

Potential nitrate toxicity problems were found only under the 288 criteria during October and November. These are months when brown trout may spawn in the downstream reach of the Truckee River. These concentrations will be influenced by several factors including upstream nitrate uptake, which will reduce concentrations.

Table 5-8. Estimated Nitrite, Nitrate and Ammonia Concentrations Below the JWPCP Outfall During Low Q_{10} Flow for River Disposal of 40 mgd[1]

	River Disposal, 406 Criteria						Toxicity Standard
	Jul	Aug	Sep	Oct	Nov	Dec	
NO_3-N	.98	.93	.83	.88	1.49	1.59	2.00
NO_2-N	.031	.029	.026	.028	.047	.050	.039
Unionized NH_3-N*	.011	.010	.009	.007	.008	.006	.016

	River Disposal, 288 Criteria						Toxicity Standard
	Jul	Aug	Sep	Oct	Nov	Dec	
NO_3-N	.86	.93	1.13	2.47	2.01	1.65	2.00
NO_2-N	.027	.029	.035	.077	.063	.052	.039
Unionized NH_3-N*	.009	.010	.012	.020	.011	.006	.016

FOOTNOTES:

*Assuming river temperatures to be:

21.°C Jul-Sep Estimated from PEL.
17.2°C Oct Estimated from DRI. Mean plus two standard deviations.
12.0 Nov Estimated from DRI. Mean plus two standard deviations.
6.8 Dec Estimated from DRI. Mean plus two standard deviations.
Also assumes maximum effluent pH and temperature.

[1] Based upon average annual effluent concentrations.

The nitrite toxicity standard is exceeded in October, November, and December during the low Q_{10} flow condition. The largest exceedence is a value of twice the standard in October under the 288 criteria. The acute toxicity concentrations, as represented by bioassay testing, is about 10 times the concentration of the toxicity standard.

The only exceedence of the ammonia toxicity standard at low Q_{10} flows occurs during October under the 288 criteria. The concentration was computed using a pH of 8.0 and an upper temperature of 17.2°C; the 17.2°C temperature was computed from DRI data as the observed mean plus 2 standard deviations. Given the variability in pH and temperature, and the fact that both high values must occur simultaneously to yield the concentration shown, it is felt that the unionized ammonia standard of 0.016 mg/l is unlikely to be exceeded. It is also important to note therefore, that Table 5-8 represents the estimated concentrations during low Q_{10} flows in the months shown, and a low Q_{10} flow in July may not necessarily be followed by a low Q_{10} flow in August. Moreover, if during a winter month with a low Q_{10} flow the JWPCP discharges at a 50 percent greater ammonia load as suggested by Kennedy/Jenks (1980), the possibility of toxic conditions will be increased.

The disposal of 40 mgd of Master Project effluent to the Truckee River will increase the phosphorus loading over the ESP load, but nitrogen loading will decrease sharply. The nitrogen to phosphorus ratio experienced with the ESP, indicative of a strongly phosphorus limiting condition, will be reduced to near an 11:1 ratio which encroaches into the ratio range stimulating algal growth. Therefore, AGP below the outfall, which will decrease following the ESP, is expected to increase slightly under the Master Project due to the 33 percent increase in phosphorus loading. Both ESP and 40 mgd Truckee River discharge AGP will be greatly reduced from current levels.

DRI found little correlation between algal growth and nitrogen concentrations at orthophosphate levels less than 0.05 mg/l. In fact, only a small amount of growth occurred at these low levels. Projected orthophosphate concentrations shown in Table 5-7 indicate that the average concentration will be slightly higher than this for Truckee River Master Project disposal but within the 0.05-0.08 mg/l range determined by DRI to be the range where accelerated algal growth begins.

Between the outfall and Vista, nutrient uptake by algae will reduce the concentrations of nitrogen and phosphorus dissolved in the water column. These nutrients will, however, return to the system via the decomposition of detrital matter and metabolic excretions.

Concentrations of dissolved nutrients should be less at Vista than below the outfall due to this uptake. During the winter months and high flow spring months, however, nutrient concentrations are expected to increase in a downstream direction. The exact timing of release patterns is unknown, since this seasonal increase would relate to die-off rate and occurrence of scouring flows.

DRI (Lider, et al., 1980) AGP data show the greatest amount of growth occurring with nutrient spikes of a combination of nitrogen and phosphorus. As the spikes are reduced, algal growth decreases. Phosphorus removal treatment is designed to cause the river to become even more phosphorus-limiting. The magnitude of any reduction in algal growth in the river that will occur after implementation of the ESP and Master Project is not defined. However, the AGP data (Lider, et al., 1980) indicate that the reduction may be large.

Between Vista and Derby Dam, nitrogen and phosphorus concentrations will remain close to the 11:1 ratio. During much of the year, both phosphorus and nitrogen are expected to be reduced to near existing background levels. The reduction in phosphorus concentrations at particular downstream locations will, of course, depend upon the degree of recycling within the system.

Disposal of the effluent in the river will impact temperature to some degree. The amount of this impact was approximated by using long-term monthly temperature data collected by DRI. Using average monthly temperatures from these data, a mass balance analysis immediately below the outfall was computed. This analysis was performed assuming complete mixing of the effluent and that temperature acts conservatively. These assumptions are not entirely correct but can be used to estimate changes. As seen from Table 5-9, the temperature below the JWPCP does not change greatly from above the JWPCP. The largest rise in temperature (2.3°C) was projected to occur in December. The predicted rise in temperature during the summer months varied from 0.6°C in July to 2.1°C in October. The larger change experienced in October is due to the fact that flows in the river are being lowered as agricultural demands are decreasing and yet air temperatures and incident sunlight are still relatively high. It appears that the discharge of 40 mgd of effluent at its maximum allowable temperature to the Truckee River would cause an average seasonal rise in river temperature of less than 3°C over ambient conditions. Discharges lower than maximum allowable temperatures will have less effect.

Table 5-9. Estimated Truckee River Temperatures
Below the JWPCP Outfall (°C)

	Truckee River Above JWPCP			JWPCP	Truckee River Below JWPCP		
	Maximum	Average	Minimum	Maximum	Maximum	Average	Minimum
SUMMER June through October	18.9	15.1	11.1	27	20.2	16.5	11.8
WINTER November through May	8.9	4.9	1.3	22	10.2	6.4	3.3

DATA SOURCE:

DRI, unpublished data; Jones & Stokes Associates and DRI, 1980; Kennedy/Jenks, 1980.

The JWPCP-induced rise in temperature in the mixing zone will gradually decrease in a downstream direction, but quantification of this temperature dissipation effect has not been attempted.

Under the AWT alternative, the JWPCP will continue to discharge carbonaceous and nitrogenous BOD. While an oxygen demand greater than background load will continue to be exercised, a beneficial effect on the dissolved oxygen concentration in the river and bottom sediments should result. Table 5-10 compares the projected and existing concentrations of oxygen-demanding material and the concentration oxygen required for nitrification or biological utilization.

With the exception of BOD, oxygen-demanding material will be reduced from existing levels. For example, the oxygen required to nitrify ammonia to nitrite and nitrite to nitrate would be reduced 97 percent for both steps. The total oxygen demand for carbonaceous and nitrogenous BOD is projected to be reduced 66 percent in terms of load and 83 percent in terms of concentration.

Reductions in total nitrogen and total phosphorus will have a beneficial effect upon DO in the Truckee River. Reductions in nutrients will cause reduced algal growth as explained earlier. This, in turn, will lessen diurnal variations in DO due to algal respiration and photosynthesis. The DO sag immediately below the treatment plant outfall, shown in Figure 4-20, should reduce in magnitude due to improvements in effluent characteristics that lower ammonia and BOD. Below Vista, diurnal DO and pH variations will be less with Truckee River discharge than at present as a result of reductions in algal growth due to the phosphorus limitation. Stabilizing the pH will also help prevent large increases in the unionized ammonia that were measured in this reach by PEL (Figure 4-22) (1979).

The AWT process, although it removes a large amount of nutrients, increases the dissolved salt load in the effluent. The effluent salt load, now about 22 tons per day, will increase because of AWT process. The daily maximum is specified in the Draft Facilities Plan (Kennedy/Jenks, 1980) to be around 83 tons per day, nearly a four-fold increase. This will cause a 43 percent increase in salt loading of the Truckee River below the outfall compared to present conditions. Below Derby Dam the salt loading will be twice the ESP conditions for AWT under the 288 criteria and about 50 percent higher under the 406 criteria. The difference between the salt loading of the two criteria is due to the division of flow at Derby Dam. The 288 criteria, which divert less water to the Truckee Canal, also send a greater amount of the salt load to Pyramid Lake.

Table 5-10. Comparison of Present and Proposed Oxygen Depleting, Nutrient and Solids Loading From the Reno-Sparks JWPCP to the Truckee River[4]

Characteristic	Units	Reno-Sparks JWPCP Effluent Discharge			Change Between Present and 40 mgd	
		Present at 20 mgd[1]	Early Start[6] at 30 mgd	Planned at 40 mgd	Units	%
[1] Oxygen Consuming Characteristics						
[2] A. BOD-Total Carbonaceous	mg/l	12	12	8	- 4	-33
BOD-Total Carbonaceous	lb/day	2,000	3,000	2,670	+ 670	+33
B. Nitrogenous BOD						
Ammonia-N	mg/l	15	15	0.5	- 14.5	-97
Nitrite-N	mg/l	2.5	1.5	0.1	- 2.4	-96
[3] Oxygen for Nitrification						
Ammonia-N	mg/l	69	69	2.3	- 66.7	-97
Nitrite-N	mg/l	3	1.8	0.1	- 2.9	-97
Total	mg/l	72	70.8	2.4	69.6	-97
Total	lb/day	12,000	17,600	800	-11,200	-93
C. Total Oxygen Demand	mg/l	84	82.8	14.4	- 69.6	-83
Total Oxygen Demand	lb/day	14,000	20,700	4,800	- 9,200	-66
D. Suspended Solids	mg/l	20	≤ 5	8	- 12	-60
Suspended Solids	lb/day	3,340	1,250	2,670	- 670	-20
E. Phosphate Total-P	mg/l	5.75	0.4	0.4[5]	- 5.15	-90
	lb/day	960	100	200	- 760	-79
F. Nitrogen-Total-N	mg/l	21.3	21.3	5.0[5]	- 16.3	-77
	lb/day	3,550	5,330	1,670	- 1,880	-53

[1] Average values of October 1977-August 1978 operation.
[2] Total carbonaceous BOD at 1.5 x
[3] Oxygen for nitrification - 4.6 $\#O_2/\#NH_4$-N and 1.2 $\#/O_2/\#NO_2$-N.
[4] Discharge for summer season June-October conditions, emissions may be increased by 50 percent for remainder of year.
[5] Annual mean.
[6] Present treatment with phostrip and tertiary filtration.

SOURCE: Pacific Environmental Laboratories, 1979.

Increases in the TDS concentration in the Truckee River will increase the salt loading to irrigated agricultural lands in the Truckee and Carson basins. The amount of water that must be passed through the soil to control soil salinity, or the leaching requirement, may therefore have to be increased. DOI (1977) studied the salt balance in the Newlands Project and found improvement in soil salinity due to irrigation. They found that between the Carson River and lower Truckee River basins, only the Carson division of the Newlands Project had a potential salt problem.

Increasing the salt load under AWT could eventually increase the soil salinity problem in the Carson division and possibly create a problem in the Truckee division. If the TDS of the irrigation water increases, the amount of water applied to the soil must be increased in order to maintain the status quo in terms of leachable salts.

The potential pollutant loading to the river below Derby Dam will vary in response to the flow released to the river at Derby Dam, as well as seepage and spills back to the lower Truckee River from the Truckee Canal.

The average annual pollutant load remaining in the lower Truckee River at Derby Dam (not diverted into the canal) was computed for each alternative including Truckee River disposal and shown in Table 5-11. This represents an estimate of the average annual load immediately below Derby Dam. The concentrations associated with this load are equivalent to the average annual concentrations above Derby Dam. The pollutant load, therefore is a percentage of the load above Derby Dam as determined by the division of flow at Derby Dam.

The pollutant load below Derby Dam will be increased by accretions from the Truckee Canal (spills and seepage) and farther downstream by agricultural return flows. During some portions of the year spills from the canal to the lower Truckee River have historically increased the pollutant load. The load eventually reaching Pyramid Lake, therefore, will be the sum of the various pollutant loads entering the river less direct diversions. As seen in Table 5-11, Truckee River disposal of the JWPCP effluent results in the largest load immediately below Derby Dam prior to the accretions from the Truckee Canal.

The load entering the Truckee River due to accretions from the Truckee Canal was estimated by taking the flow accretion from the canal, as computed from the hydrologic model, and applying this to the pollutant load at the head of the canal. The estimated accretions to the river from the canal are shown in Table 5-12. Comparison of this estimated accretion with the historical data collected by DRI (Appendix D) and PEL (Table 4-17) reveals that much more TDS and chloride

Table 5-11. Computed Average Annual Pollutant Load By-Passed at Derby Dam to the Lower Truckee River, Excluding Spills and Seepage From the Truckee Canal (lbs/day)*

	288 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)	Truckee River Disposal (20 mgd)[1]
Total Nitrogen	2,913	4,014	2,608	3,394
Total Phosphorus	126	232	113	526
TDS	109	173	98	80
Chloride	18,190	27,826	16,280	14,120

	406 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)	Truckee River Disposal (20 mgd)[1]
Total Nitrogen	2,124	2,914	1,860	3,394
Total Phosphorus	92	165	82	526
TDS	80	123	70	80
Chloride	13,260	20,189	11,613	14,120

FOOTNOTES:

*Except TDS which is in tons/day.

[1] Base case, computed from existing loading and simulated current flow regime, utilizing the same assumptions as the 40 mgd case.

DATA SOURCE:

Jones & Stokes Associates and Dri, 1980; Kennedy/Jenks, 1980; PEL, 1979.

enter the river than is shown by the computed accretion from canal loads. In addition, it appears that the estimates of accretions from the canal overstate the total nitrogen load; there may be soil uptake or other reductions of nitrogen between the canal and river or within the river. Table 5-13 illustrates the load in the river above Nixon after this accretion enters, and represents the sum of the load left in the river (not diverted) at Derby Dam and accretions to the river. It also represents the load present before any other diversions or returns in the lower river.

A second method for estimating the pollutant load at Nixon was also used. It entails adding the estimated change in pollutant load as measured by PEL (1979) between Wadsworth and Nixon to the estimated load bypassed at Derby Dam. The loads, shown in Table 5-14, assume that the accretion is independent of canal flow and quality, and that the PEL samples are representative of the conditions below Derby Dam. Since only one sample was taken at a flow above 52 cfs (874 cfs at Wadsworth, May 1978) it is possible that much of the organic nitrogen load in the lower river escaped PEL's measurements.

Comparing Tables 5-13 and 5-14, it is obvious that there are accretions of TDS and chlorides to the lower river other than those estimated by the first method. Also, it appears that total nitrogen experiences reductions between Derby Dam and Nixon. This can be seen by comparing total nitrogen for river disposal in Tables 5-6 and 5-13. The estimated total nitrogen accretion from canal spills and seepage (Table 5-12) is larger than the PEL-measured change in total nitrogen loading from Wadsworth to Nixon. Part of the difference may be accounted for by other accretions between Derby Dam and Wadsworth, which were unmeasured by PEL. However, given the reduction in total nitrogen loading from the JWPCP, it can be assumed that there is some nitrogen uptake in the soil. There is probably a temporary sink for nutrients in the Truckee River itself from algal uptake. It is felt therefore, that the total nitrogen accretion will actually be less than the values shown in Table 5-12, and that TDS and chloride values will be higher. The total phosphorus accretion is expected to be similar to that shown in Table 5-12. Table 5-12 therefore, is an underestimation in terms of TDS and chloride and an overestimation in terms of total nitrogen.

One of the primary concerns about the Truckee River below Derby Dam is algal growth. DRI (1980) investigated the algal growth potential at Nixon and found the Truckee River to be nitrogen-limiting based upon a total soluble inorganic nitrogen to orthophosphate ratio of 11:1 as the limiting nutrient determination.

Table 5-12. Computed Accretions to the Truckee River in the Derby Dam-Pyramid Lake Reach (lbs/day)*

	288 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)[2]	Truckee River Disposal (20 mgd)[1]
Total Nitrogen	1,559	183	131	387
Total Phosphorus	30	10	6	61
TDS	14	9	5	9
Chloride	2,752	1,402	822	1,607

	406 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)[2]	Truckee River Disposal (20 mgd)[1]
Total Nitrogen	1,332	274	195	387
Total Phosphorus	28	15	8	61
TDS	15	12	7	9
Chloride	2,794	1,903	1,224	1,607

FOOTNOTES:

*Except TDS which is in tons/day.

[1] Base case, computed from existing loading and simulated current flow regime, utilizing the same assumptions as the 40 mgd case.

[2] Assumes no return flow from Dodge Flat.

DATA SOURCE:

Jones & Stokes Associates and DRI, 1980; Kennedy/Jenks, 1980; PEL, 1979.

Table 5-13. Estimated Pollutant Loads at Nixon Including Accretions Estimated From PEL-Measured Quality Changes between Derby Dam and Nixon (lbs/day)*

	288 Criteria						
	Estimated Pollutant Load Below Derby Dam[1]			Pollutant Load Accreted To the Lower Truckee River[2], Existing Conditions	Estimated Pollutant Load at Nixon[3]		
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal[4] (40 mgd)		Truckee Canal (40 mgd)	Truckee River (40 mgd)	Dodge Flat (40 mgd)
Total Nitrogen	2,913	4,014	2,608	103	3,016	4,117	2,711
Total Phosphorus	126	232	113	130	256	362	243
TDS	109	173	98	29	138	202	127
Chloride	18,190	27,826	16,280	18,463	36,653	46,219	34,743

	406 Criteria						
	Estimated Pollutant Load Below Derby Dam[1]			Pollutant Load Accreted To the Lower Truckee River[2], Existing Conditions	Estimated Pollutant Load at Nixon[3]		
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal[4] (40 mgd)		Truckee Canal (40 mgd)	Truckee River (40 mgd)	Dodge Flat (40 mgd)
Total Nitrogen	2,124	2,914	1,860	103	2,227	3,017	1,963
Total Phosphorus	92	165	82	130	222	295	212
TDS	80	123	70	29	109	152	99
Chloride	13,260	20,189	11,613	18,463	31,723	38,652	30,076

FOOTNOTES:

*Except TDS which is tons/day.
[1] From Table 5-11.
[2] From PEL, 1980. Difference between Wadsworth and Nixon pollutant loads.
[3] Summation of load below Derby Dam and accretion.
[4] Assumes no return flows from Dodge Flat.

DATA SOURCE:

Jones & Stokes Associates and DRI, 1980; Kennedy/Jenks, 1980; PEL, 1979.

Table 5-14. Estimated Truckee River Pollutant Load Near Nixon. Computed as the Summation of the Pollutant Loads Retained in the River at Derby and Accretions Calculated From Truckee Canal Spills and Seepage[1] (lbs/day)*

	288 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)[3]	Truckee River Disposal (20 mgd)[2]
Total Nitrogen	4,472	4,197	2,739	3,781
Total Phosphorus	156	242	119	587
TDS	123	182	103	89
Chloride	20,940	29,228	17,102	15,727

	406 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)[3]	Truckee River Disposal (20 mgd)[2]
Total Nitrogen	3,456	3,188	2,055	3,781
Total Phosphorus	120	180	90	587
TDS	95	135	77	89
Chloride	16,054	22,092	12,837	15,727

FOOTNOTES:

*Except TDS which is tons/day.
[1] From Tables 5-11 and 5-12.
[2] Base case, computed from existing loading and simulated current flow regime, utilizing the same assumptions as the 40 mgd case.
[3] Assumes no return flows from Dodge Flat.

DATA SOURCE:

Jones & Stokes Associates and DRI, 1980; Kennedy/Jenks, 1980; PEL, 1979.

Whether or not the river below Derby Dam will remain in a nitrogen-limiting state will be dependent upon the accretions to the lower river and the nutrient load bypassed at Derby Dam. The nitrogen load to the river from canal seepage will enter mostly as nitrate. This is supported by work done in the upper watershed regarding the movement of nitrogen through the soil (Lahontan RWQCB, 1979). If the total nitrogen load bypassed at Derby Dam (Table 5-11) is amended to reflect total soluble inorganic nitrogen (assuming total soluble inorganic nitrogen is 45 percent of total nitrogen for river disposal [Table 5-4] and that the accretion enters the river as nitrate), the total soluble inorganic nitrogen:orthophosphate ratios were computed and found to reflect a phosphorus-limiting situation for both criteria and all disposal options. For river disposal, the ratios were found to be close to the 11:1 ratio and could fall on either side of the ratio depending upon the percent of total nitrogen assumed to be occupied by total soluble inorganic nitrogen.

The AGP tests conducted by DRI (1980) found that in the nitrogen-limiting condition at Nixon, the addition of phosphorus did not stimulate a significant amount of growth. Additions of nitrogen and combinations of nitrogen and phosphorus stimualted growth.

All three disposal options should reduce algal growth relative to current conditions. This is due not only to the reduction in nitrogen loading, but also the drastic reduction in phosphorus loading. With the nutrient reductions, algal growth will be limited at a biomass less than current conditions and growth will be limited by phosphorus. The magnitude of this biomass reduction is unknown. Table 5-15 shows the estimated ratio of a total insoluble nitrogen to phosphorus for each alternative including Truckee River disposal.

River disposal exhibits ratios where either nutrient could be closer to limiting, indicating that nearly all nitrogen and phosphorus will be available for algal growth. River disposal will produce the largest algal growth stimulation potential of the three disposal options. As compared with current and ESP conditions, the three disposal options will reduce algal growth due to reductions in nutrients.

The quality conditions during individual months in the lower river will reflect the uptake and release of the nutrients. PEL (1979) reported total nitrogen and total phosphorus concentrations at Nixon which were less than the concentrations reported between Steamboat Creek and Derby Dam, although they were still higher than concentrations above Steamboat Creek. Uptake of nitrogen and phosphorus is probably the primary cause of the reduction. As flow begins to drop and temperatures rise during the summer, nutrients are taken up. Conversely, as

Table 5-15. Estimated Total Soluble Inorganic Nitrogen to Orthophosphate Ratios Near Nixon for the Various Disposal Options, 40 mgd Discharge[1]

	Truckee River Disposal	Dodge Flat Disposal	Truckee Canal Disposal
406 Criteria	10.8:1	11.0:1	26.8:1
288 Criteria	11.6:1	12.5:1	21.9:1

FOOTNOTES:

[1] Total soluble inorganic nitrogen as N, orthophosphate as phosphorus.

DATA SOURCE:

Jones & Stokes Associates and DRI, 1980.

nutrients are released into the system during winter months, the flows are generally increasing, diluting the increased loads. Although this does not change the total load to Pyramid Lake, it does affect the achievement of standards in the river.

The achievement of standards on an average annual basis can be estimated from Table 5-7 and is presented in Appendix E. The loads passed to the river below Derby Dam were added to accretions from canal spills and seepage, and then adjusted to reflect changes measured by PEL between Derby Dam and Nixon.

The estimated average annual concentrations are shown in Table 5-16. Slight exceedences of standards are calculated for both total nitrogen and total phosphorus in some of the cases.

Pyramid Lake

The proportion of water, and thus wastewater discharging to Pyramid Lake, depends primarily on the amounts diverted into the Truckee Canal, although some smaller diversions occur below Derby Dam. Factors in addition to water flow influence the amounts of JWPCP wastewater constituents that reach Pyramid Lake. For example, particulate matter and chemicals that absorb on particulate matter may settle into bottom sediments. Biologically active substances are consumed and converted into biomass for long-term storage. Some JWPCP wastes enter the atmosphere or become part of the humic soil in bottom sediments. Through biological processes nutrients, such as nitrogen and phosphorus, stimulate plant and then animal growth which through waste excretion or death and decay put the nutrients back into the aquatic system. Over time, nutrient materials added by the JWPCP move down the river and a portion ends up in Pyramid Lake. Nutrients do not necessarily flow directly from the JWPCP to Pyramid Lake. However, it is assumed that during a given water year a steady-state condition exists where all nutrients not lost or diverted from the system end up in the lake.

Investigations, such as those done by PEL (1979), illustrate the total process by showing the magnitude of periphyton and benthic invertebrate biomass in a sense stored in the river. A precise mechanism to illustrate the time-related flow and form of nutrients conveyed from the JWPCP to Pyramid Lake has not been assembled. It is assumed that total nitrogen and total phosphorus movement from the JWPCP to Pyramid Lake are practical indicators of the proportional effects of the Master Project. Other potential pollutants originating from the JWPCP may also enter the lake, but among the other wastewater constituents studied by PEL (1979), none is thought to have significant effects.

Table 5-16. Estimated Average Annual Concentration of Various Constituents in the Lower Truckee River (mg/l)

	288 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal[3] (40 mgd)	Standard
Total Nitrogen	.97	.84	.56	.75[1]
Total Phosphorus	.06	.08	.04	.05[2]
TDS	104	140	82	260
Chloride	19	25	15	69

	406 Criteria			
	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)	Dodge Flat Disposal[3] (40 mgd)	Standard
Total Nitrogen	.89	.75	.49	.75
Total Phosphorus	.05	.07	.04	.05[1]
TDS	95	122	51	260
Chloride	17	22	13	69

FOOTNOTES:

[1] mg-N/L
[2] mg-P/L
[3] Assumes no return flows from Dodge Flat.

DATA SOURCE:

Jones & Stokes Associates and DRI, 1980; Kennedy/Jenks, 1980; PEL, 1979.

Pyramid Lake.

Total nitrogen is of major concern to those agencies and individuals interested in the long-term welfare of the lake. In Chapter 4 it was noted that the lake is nitrogen-limited, having concentrations of NO_3-N typically less than 0.03 mg/l. AGP assays indicate that increases in soluble NO_3-N between about 0.05 and 0.5 mg/l greatly stimulate algal growth (Lider, et al., 1980). Consequently, soluble nitrogen entering the lake may immediately stimulate algal growth. Insoluble nitrogen will also contribute to algal growth as it is biologically or physically converted to a soluble form. Consequently, the total load of nitrogen annually discharged to the lake can be viewed as a potential source of nutrient in the long term.

Based on average historical river flows and average JWPCP effluent total nitrogen concentrations, it is estimated that about 4,197-3,188 pounds per day of total nitrogen could be discharged to Pyramid Lake when the 40 mgd Master Project is in full operation. This would be a decrease of 3,113-2,405 pounds per day or 43 percent from the 30 mgd ESP load, and after over 20 years of operation it would represent a 16 percent decrease from the 1978 JWPCP load.

Between about 1978 and implementation of the Master Project, the total nitrogen load will first increase by about 48 percent and then decrease, because nitrogen removal does not come on line until the Master Project is constructed. It is assumed that algal growth and overall productivity will increase during the interim period, but tools and data to project the magnitude of increased eutrophication are not available. Upon implementation of the Master Project it is expected that the decrease in the present total nitrogen load, which will change from an initial reduction of about 23 percent to 16 percent after 20 years, will diminish algal growth in Pyramid Lake over the ESP load levels. This assumption depends on other total nitrogen sources remaining at present levels during the planning period. Improved nonpoint source, urban and agricultural runoff remedies could possibly reduce the load even more.

Based on this total annual load analysis, it appears that the Master Project river disposal alternatives, by removing total nitrogen to an average of 5 mg/l in the effluent, will significantly diminish the risk of excessive eutrophication of Pyramid Lake. Quantification of the actual effects can only be observed over the long-term from field data; otherwise, a nutrient budget and algal growth model needs to be constructed and verified to project long-term trends.

Pyramid Lake is not presently phosphorus-limited with a nitrogen to phosphorus ratio of about 2:1. This condition could change if relatively large amounts of nitrogen were discharged to the lake, but as expressed earlier, that does not seem very likely to occur. The total phosphate phosphorus (TPO_4-P) load in 1978 was about 587 pounds per day. The 30 mgd ESP, which includes phosphorus removal in the treatment process, should lower this load to about 200-153 pounds per day depending on the amount of water diverted into the Truckee Canal. With a 10 mgd increase in effluent from implementation of the 40 mgd Master Project, the total phosphorus load would then increase to about 180-242 pounds per day.

Overall the total phosphorus load should diminish by about 69 percent from the present until reaching 40 mgd of effluent, if river flow and other phosphorus inputs remain the same as in the past. Because of the large amounts of naturally occurring phosphorus in the system, reductions in loading associated with the JWPCP are not expected to cause observable reductions in algal growth. There may be subtle effects in species composition but data are not available to make any conclusions.

Sedimentation of the lake will not be directly affected by the filtered effluent of the JWPCP Master Project. Secondary sources of sediment to the system are expected to increase as long as soil surfaces are disturbed by construction and agriculture. Organic particulate matter or detritus, which is a component of the suspended sediment load, may increase generally in proportion to the total nutrient load carried by the river. The flux of detritus in the system is primarily influenced by biomass accumulation, death and decay, and water current velocity. Scouring of the stream during high flow periods, e.g., April, May, and June, may cause a general movement of organic materials from the river into Pyramid Lake. A description of this flux has not been prepared although Figure 4-8 suggests a periodic change in periphyton biomass in relation to season and river discharge.

Detritus entering the lake also provide an immediate source of food for many benthic and pelagic invertebrates in Pyramid Lake, increasing their productivity. Mass inputs of detritus can place an excessive oxygen demand on a lake, but there is no indication of this occurring in Pyramid Lake.

Continued river discharge from the JWPCP Master Project at 40 mgd does not appear to directly influence the amount of water discharging to the lake. The water operations scenarios indicate a secondary reduction in total river flow of 0-5 percent and any reduction in inflow to Pyramid Lake is expected to be viewed by the Paiute Indian Tribe as adverse and significant. It should be recognized that the scenarios do not include any water conservation practices on the part of Reno and Sparks as required by grant conditions on the ESP (see Chapter 2). Reno and Sparks are in the process of considering water conservation measures. Water conservation and other water operations changes could lessen and perhaps avoid the secondary growth effects. Considering the list of possible events that may eventually influence flow to the lake, it is concluded that river discharge need not alter the amount of river flow reaching Pyramid Lake.

There is nothing in the available data to indicate that fish and wildlife in the lake will be significantly directly affected by Master Project river discharge. Long-term reductions in nutrient loading may have some secondary benefits for trout, such as diminished risk for low levels of dissolved oxygen in the hypolimnion and less intense algal blooms, but magnitudes of change are unpredictable at present. On the other hand, treated municipal wastewater always poses some level of risk to downstream biological resources. The total list of potential pollutants, toxics, carcinogens and mutagens in a waste stream is never fully known. The sensitivities of most species to such substances is barely recognized. The insidious nature of toxic and carcinogenic effects through long-term bioaccumulation of exotic chemicals are not well described. Consequently, if for no other reason than lack of knowledge, it is assumed that wastewater discharge to the river and then to Pyramid Lake poses a low risk of undefined dimension to flora and fauna in the lake.

Truckee Canal

Part of the Truckee River flow is diverted into the Truckee Canal at Derby Dam. Water quality conditions in the canal will reflect those in the Truckee River above the diversion point. It was assumed that pollutant loads would be divided proportional to the flow split at Derby Dam, since details on nutrient uptake and releases in the upstream Truckee River are lacking.

Phosphorus loads will be increased by 33 percent over ESP loading, but decreased over existing conditions. Nitrogen loads will be reduced, lessening the algal growth potential in the Truckee Canal in addition to reducing the amount of oxygen demanding material.

The TDS and chloride loads are projected to increase over current and ESP conditions. This will primarily impact the use of Truckee Canal water in the Carson division of the Newlands Project.

Lahontan Reservoir

Water that is not spilled, diverted, or lost to the Truckee Canal by seepage flows into Lahontan Reservoir. Neither the amount of nor the scheduling of water flowing into Lahontan Reservoir would be affected by river disposal. The potential for eventual alterations in the diversion of Truckee River water to the reservoir is accommodated by the 288,000 and 406,000 acre-feet TCID operations scenarios. Waste loading to the reservoir is therefore a function of the hydrology represented by these scenarios.

The total pollutant loading to the terminus of the Truckee Canal and thus Lahontan Reservoir was computed for all three disposal options (Table 5-17). This was done by taking the head of canal loads (Table 5-18) and subtracting the load lost from the canal due to subsurface depletion and diversions to bench lands. Truckee Canal flows are often diverted before entering Lahontan Reservoir or are partially released at the dam during the irrigation season. Therefore not all of the canal load at the head will enter Lahontan Reservoir during the irrigation season, while the entire terminal Truckee Canal loads would be available to Lahontan Reservoir during the nonirrigation season. The assumption that canal water short circuits the reservoir during the irrigation season may be faulty. The canal discharges to the surface while water release is from the bottom of the reservoir. Since no numerical analysis was made to estimate the percentage of the canal terminal load that may short circuit Lahontan Reservoir, it was assumed that the complete load entered the reservoir.

As seen in Table 5-19 the average loading to Lahontan Reservoir is least for the land disposal option, followed by river disposal and canal disposal. The average total AGP studies by DRI (Lider, et al., 1980) show the reservoir near the dam to be limited by insufficient soluble nitrogen. Single spikes of nitrate in AGP tests stimulated algal growth while additions of dissolved phosphate did not stimulate growth. These results tend to confirm the interpretation of existing water quality data (see Chapter 4). The phosphate load from the Carson River is relatively large (Table 5-19). Thus, the nitrogen-limited condition stimulates greater concern about continued nitrogen loading of the reservoir than phosphorus loading. In AGP tests, algae respond to concentrations of soluble nitrogen which are present in lesser amounts than the total nitrogen reported here in the impact analysis; however, over 1 or more years the instantaneous concentration of soluble nitrogen is assumed to be a function of the long-term load of total nitrogen. The results of changes in total load are likely to be reflected over several seasons rather than during any particular season.

At average historical river and Truckee Canal flow conditions and wastewater discharge from the JWPCP in 1978, the existing annual total nitrogen load to Lahontan Reservoir was estimated to be 1,947 pounds per day. Between now and full use of the 30 mgd ESP, the average annual load increases from 1,947 pounds per day to as much as 2,183 pounds per day (Table 5-4).

Table 5-17. Computed Average Annual Pollutant Load at the Terminus of the Truckee Canal for Each Alternative, (lbs/day)[1]

	288 Criteria			
	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (20 mgd)[2]
Total Nitrogen (N	410	283	3,890	1,947
Total Phosphorus (P)	23	12	76	302
TDS	17	10	37	46
Chloride	2,847	1,766	4,634	8,103

	406 Criteria			
	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (40 mgd)
Total Nitrogen (N)	1,208	742	5,037	1,947
Total Phosphorus (P)	71	32	109	302
TDS	53	28	60	46
Chloride	8,730	4,634	11,013	8,103

FOOTNOTES:

[1] Except TDS which is in lbs/day.
[2] Present conditions, computed from present loading, existing river management criteria, otherwise same assumptions as 40 mgd case.

DATA SOURCE:

PEL, 1979; Kennedy/Jenks, 1980; Jones & Stokes Associates and DRI, 1980.

Table 5-18. Average Computed Annual Pollutant Load at the Head of the Truckee Canal (lbs/day)*

	288 Criteria			
	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)	Truckee Canal Disposal (40 mgd).	Truckee River Disposal (20 mgd)[1]
Total Nitrogen	838	608	7,497	2,819
Total Phosphorus	47	26	147	437
TDS	35	22	70	67
Chloride	5,820	3,800	13,270	11,727

	406 Criteria			
	Truckee River Disposal (40 mgd)	Dodge Flat Disposal (40 mgd)	Truckee Canal Disposal (40 mgd)	Truckee River Disposal (20 mgd)[1]
Total Nitrogen	1,940	1,356	8,285	2,819
Total Phosphorus	110	58	180	437
TDS	82	51	98	67
Chloride	13,457	8,467	16,940	11,727

FOOTNOTES:

*Except TDS which is tons/day.

[1] Present conditions, computed from current loading and simulated flow regime, utilizing the same assumptions as the 40 mgd case.

DATA SOURCE:

PEL, 1979; Kennedy/Jenks, 1980; Jones & Stokes Associates and DRI, 1980.

Table 5-19. Average Loads of Selected Potential Pollutants Discharged into Lahontan Reservoir

Hydrology Scenario	Base Condition[2]	A-Average Daily Load in lbs/day for 12-Month Period[1]					
		Truckee River Disposal		Dodge Flat Disposal[3]		Truckee Canal Disposal	
		288	406	288	406	288	406
Total Nitrogen-N	1,947	410	1,208	283	742	3,890	5,037
Total Phosphorus-P	468	23	71	12	32	76	109
Chloride	8,103	2,847	8,731	1,767	4,634	6,227	11,014
Total Dissolved Solids (TDS)	46[1]	17	53	11	28	37	60

FOOTNOTES:

[1] TDS in tons/day.
[2] Average historical flow condition with present effluent quality.

Hydrology Scenario	Base Condition	B-Average Total Load of Phosphate Phosphorus in grams/m²/yr Entering Lahontan Reservoir					
		Truckee River Disposal		Dodge Flat Disposal[3]		Truckee Canal Disposal	
		288	406	288	406	288	406
Truckee Canal	1.80[1]	0.13	0.79	0.08	0.03	0.41	1.10
Combined Truckee Canal and Carson River	4.42[2]	2.95	5.20	2.89	4.82	2.94	5.42

FOOTNOTES:

[1] Average historical flow with present effluent quality.
[2] Average flow and total PO_4-P concentrations in Carson River.
[3] Assumes no return flow from Dodge Flat.

DATA SOURCE:

Jones & Stokes Associates and DRI, .

The Master Project at 40 mgd would decrease this load to 1,208 pounds per day at the 406,000 TCID operating criteria or 410 pounds per day at the 288,000 criteria. At the time the ESP is converted to the Master Project, the nitrogen load to Lahontan Reservoir could be reduced by 77 percent, which diminishes to a 45 percent reduction as the effluent discharged increases from 30 mgd to 40 mgd.

The total phosphorus load would decrease from the present 468 pounds per day to 23-71 pounds per day. The decrease in total phosphorus loading after 20 years of operation amounts to a possible reduction of 95 percent, depending on TCID operations. An estimation of areal loadings for total phosphorus is given in Table 5-19 which gives some idea of the relative relationship of the Truckee Canal and Carson River discharges.

The reservoir during this 20-year period is expected to remain nitrogen-limited. It is difficult to speculate about the precise nature of any ecological change in the reservoir without the use of mathematical models and adequate nutrient budget data to interpret the relative significance of annual changes in nutrient loading. Judgmentally, it is expected that algal bloom conditions in the lower end of the reservoir will either stabilize or decrease with the expected reduction in nutrient loadings. Consequently, there should be improvement in habitat conditions for all aquatic fauna, and sport fishing and recreational uses should be improved. Filtration of the effluent at the JWPCP should reduce pathogenic risks to public health, but risks from toxicants, carcinogens, mutagens, and taste and odor agents are not expected to appreciably change. The effects of using Lahontan Reservoir water on agricultural soils and crops are not expected to measurably change from present circumstances.

Fish and Wildlife

Fish. Water quantity and quality and other features of the aquatic habitat were described and discussed in Chapter 4. Changes in aquatic habitat resulting from the Master Project discharge to the river are identified in preceding sections of this chapter. It is assumed that the overall well-being of fish is proportional to beneficial and adverse alterations of the habitat. These alterations are assumed to correspond to decreases and increases in the amounts of pollutants discharged to the river. The analysis of future effects of the Master Project on fish must be essentially judgmental and based on available data (PEL, 1979; Kennedy/Jenks, 1980; Lider, et al., 1980; Koch, et al., 1979) and available methods of using the data for predictive purposes. Perhaps in the near future, following a period of operation of the ESP and analysis of data being collected by the USGS, more precise projections will be possible.

The ESP will partially abate a major adverse impact on aquatic organisms by reducing residual chlorine in the effluent to 0.01 mg/l or less. The receiving water standard is 0.002 mg/l. Acutely toxic conditions from chlorine may sometimes be evident at the mouth of Steamboat Creek, but combined with dilution and the chlorine demand of the receiving water, any remaining toxicity is expected to occur only near the point of discharge. Phosphorus removal to about 0.5 mg/l (PO_4-P) is expected to reduce algal productivity downstream of Vista which in turn may reduce pH and the risk of toxicity from unionized ammonia. The receiving water monitoring, which is mandated as an EPA grant condition (see Chapter 2) on the ESP, may ascertain the actual effects of these remedial actions between the present and implementation of the Master Project.

The Master Project will provide wastewater treatment to remove the remaining acute and chronic toxicities caused by nitrite, nitrate and ammonia. Relocation of the point of discharge to two locations will provide improved effluent dispersion and dilution over the Steamboat Creek discharge (PEL, 1979). The two outfall locations should decrease the risk that fish will encounter the effluent plume; that effluent will cause blockage of the cross-sectional area of the river; and that large benthic areas will be severely impacted by the discharge. Filtration of the effluent to remove suspended materials will reduce effluent turbidity and further improve benthic habitat immediately downstream of the point of discharge by limiting the amount of putrescible organic matter that can settle into the bottom substrate. These are major benefits to the aquatic habitat and fish.

The Master Project is not expected to significantly alter instream flow or related habitat uses. Urbanization and the conversion of water use from agriculture to municipal uses should not measurably affect average monthly flow conditions, but may affect instream flows during 1-in-10-year low flow months by less than 5 percent (see Table 4-5). Growth effect estimates were based on present water use patterns and water conservation programs may negate the projections made in the scenario analysis (Table 4-5). It is concluded that instream flow will not be altered by implementation of the Master Project river disposal option to levels that significantly diminish fish habitat.

Operation of the Master Project of 40 mgd at the proposed effluent requirements (Kennedy/Jenks, 1980, Table 2-3) should enable fish and other organisms to safely enter the effluent mixing zone. Acutely toxic conditions from chlorine, nitrite, ammonia, and nitrate should not occur even at 1-in-10-year low flows. Chronic toxicity could occasionally but infrequently be present in the zone of mixing and downstream from nitrate, nitrite and ammonia (Table 5- 8).

During some low flow months toxicity standards for these potential toxicants were slightly exceeded in the mass balance analysis. For example, the scenario analysis indicates that the nitrate standard of 2 mg/l NO_3-N would be exceeded in October under the 288 operating criteria by 0.47 mg/l. The values of standards exceedence in Table 5-8 are not thought to be greatly significant, but the trend of higher concentrations during October, November and December may be of potential importance to brown trout spawning activities. It is concluded that the estimated exceedences of river standards are too small to be considered significant adverse impacts on fish; however, they do indicate a concern about low flow conditions that may warrant consideration in the design of projects to monitor Master Project operations.

Acutely toxic conditions may occur if the treatment facilities fail to an extent that effluent requirements are not met. During plant failures, which are expected to occur, the effluent would continue to flow into the river and fish and other organisms may be killed. These events would probably be short-term, i.e., less than 3 days and infrequent, but when catastrophic events occur they are typically viewed as significant violations of the discharge permit and receiving water standards. The importance of failures becomes greater as downstream beneficial uses grow in value as a result of typical plant operations.

The quality of downstream aquatic habitat has also been degraded by excessive nutrient enrichment, which tends to depress concentrations of dissolved oxygen especially at night and in bottom sediments (Chapter 4). Aufwuchs materials that grow on bottom sediments and the decompositions of organic matter in the sediments tend to impair the habitat for use by trout, whitefish, and other species native to the river. Some exotic species such as carp and catfish can benefit from the enrichment if it is not too severe. The impairment of salmonid spawning habitat is probably the most limiting feature of nutrient enrichment. Trout require DO concentrations of 7 mg/l or greater in spawning gravels to adequately reproduce. Although data reporting DO concentrations in spawning gravels were not discovered, it is assumed that concentrations are impaired between Steamboat Creek and Derby Dam.

Phosphorus removal features of the ESP and Master Project are expected to limit algal growth on the river to biomass levels less than those reported by PEL (1979). Oxygen conditions in the benthic habitat are expected to improve over 1977-1978 conditions. The level of improvement is unpredictable, but monitoring programs required for the ESP should track these impacts and allow for projections into future Master Project conditions.

Implementation of the Master Project with river disposal is expected to remove conditions now caused by the JWPCP that limit occupancy of the river by trout and other fishes. Habitat conditions that fully support trout spawning and reproduction in the reach between Steamboat Creek and Nixon may not occur in many years because of the putrescible, organic content in bottom sediment and high water temperature. The Master Project is expected to continue to be the most significant source of nutrients to the river. Temperature, on the other hand, is not significantly affected by the JWPCP discharge (Table 5- 9).

Endangered Fish - Cui-ui. Available data do not indicate that the cui-ui will be directly and significantly affected by normal operations of the Master Project using river disposal. The data do not show that enrichment of the Truckee River or other waste substances from the JWPCP are now limiting factors for the cui-ui. The Master Project is projected to improve existing water quality conditions and reduce total nutrient inflow to Pyramid Lake. These improvements should augment other actions being taken by the USFWS to recover the species (USFWS, 1978) over a long period time that is undefined. Nutrients, salts, and other wastewater constituents entering Pyramid Lake may alter this cui-ui habitat, but the degree of change is not projected. The JWPCP will continue to add to the nutrient and salt load of Pyramid Lake.

Massive failure of the wastewater treatment system could conceivably damage cui-ui by causing toxic and low dissolved oxygen conditions to occur in the lower Truckee River. This type of impact may be significant depending on season, amount of river flow passing Derby Dam and duration of plant failure.

Threatened Fish - Lahontan Cutthroat Trout. Adult and juvenile trout, including cutthroat trout, are expected to survive and grow in the river when river temperatures are less than 21-23°C except perhaps at the immediate point of discharge. Discharge to the river may continue to impair trout habitat between the JWPCP outfall and Derby Dam by causing spawning habitat to be less than optimum quality. Aufwuchs growths on rocks and gravel and the penetration of decomposing organic matter into spawning gravel establishes a significant risk that DO concentrations in gravels will be insufficient for normal egg and sac fry growth and survival. Confirmation or denial of this type of impact must be derived from monitoring studies following implementation of the ESP. Implementation of the Master Project is not expected to significantly alter seasonal cutthroat trout habitat below Derby Dam or in the Truckee Canal.

Wildlife. There is no indication that wildlife will be directly affected by the Master Project Truckee River disposal options.

Groundwater

The discharge of effluent to the Truckee River is not expected to have any direct effect on Truckee Meadows groundwater. The AWT river disposal alternatives (Alternatives T-5, T-6a, T-9, and T-15) will place the diluted effluent in contact with the groundwater adjacent to the Truckee River in an area that is generally believed to contribute groundwater flow to the river. The diluted effluent is not expected to percolate into the groundwater, since this would be contrary to the prevailing gradient.

The Truckee Canal will carry diluted effluent and will recharge groundwater that supplies wells in the Fernley and Wadsworth areas, as well as areas along the canal and its distributaries. The quality of this recharge water will be improved over existing conditions, but slightly degraded compared to ESP conditions. No significant impacts on beneficial uses of this groundwater are anticipated.

Water Supply

River disposal of AWT effluent will perpetuate the current pattern of domestic use of highly diluted wastewater in Hazen, and in Fernley, Wadsworth, Fallon, and other areas relying on Truckee River and Truckee Canal water. Risks to public health from use of this water are expected to decrease from the present level with the ESP, and then increase slightly as Master Project flows increase from 30 mgd to 40 mgd. No violations of EPA primary drinking water standards are expected to be caused by the effluent.

Potential Risks to Public Health

Some risk from public exposure to sewage exists at every wastewater treatment and disposal operation. Treatment and disinfection are designed to reduce the level of risk, but in general risk is proportional to the degree of human contact with the wastewater and the adequacy and reliability of the treatment process. Considerable information is available to indicate that the treatment and disinfection processes proposed for the river disposal alternative are effective in greatly reducing the risk for infection from viruses, bacterial pathogens, parasites and heavy metals. Inadequate information is available to judge treatment effectiveness relative to refractive organic chemical agents.

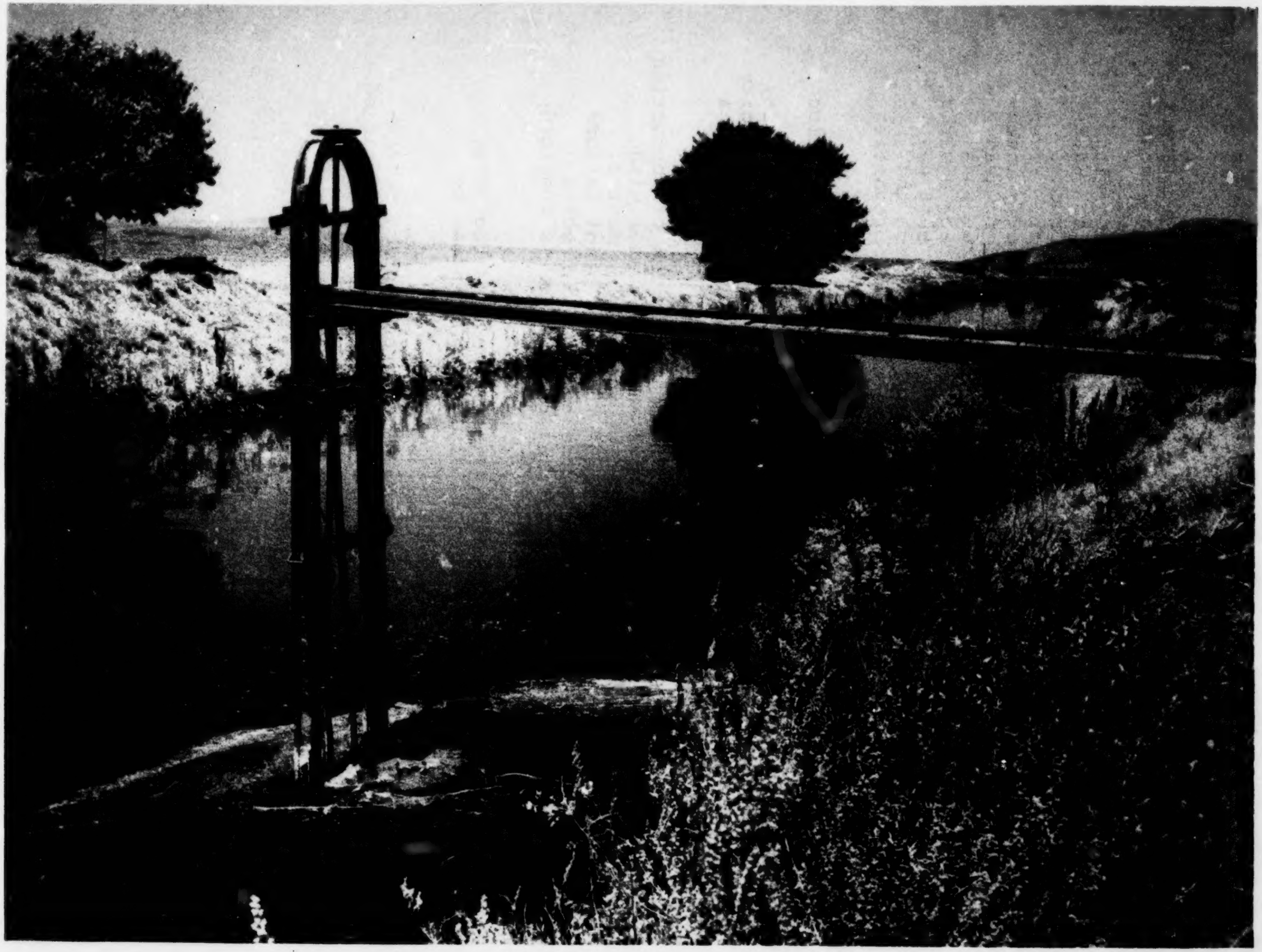
Opportunity for human contact and ingestion are important considerations in evaluating public health risks. Body contact recreation, i.e., swimming, is less a risk than domestic water supply. Opportunities for contact and ingestion with river diposal do not involve large numbers of persons. Water-contact recreational uses of the Truckee River and Truckee Canal are not intensive, although swimming does occur. River use for direct domestic water supply has not been fully inventoried although it is reported to occur. The Town of Hazen, a community of about 20 residences, withdraws Truckee Canal water for domestic uses. Wells located in the shallow aquifer near the river are probably drawing on river water that has filtered through soil for domestic supply. Livestock and wild game drink river water. These uses create opportunities for infection with viruses, bacteria and parasites.

The JWPCP Master Project will include effluent filtration in addition to chlorination to reduce the risk for human contact with pathogens. Filtration offers an added opportunity to remove infective agents that may escape the chlorine toxicity because of a resistant stage or being imbedded in particulates not penetrated by the chlorine.

Dilution with river flow also reduces the risk of contacting an infective dose. The level of risk thus fluctuates with river flow and will tend to be highest in low flow months, e.g., October, and during dry years. Treatment plant failure and the discharge of inadequately treated or disinfected effluent also increase risk especially if failure is combined with low dilution flows.

The greater the distance downstream the less the level of risk, because infective agents die or are consumed by river fauna over time.

There is a level of health risk to water-contact recreationists and domestic water supply users that is not quantified. During normal Master Project operations and average river flows the risk is reduced to commonly accepted levels, which are based on general observations that there is no evidence of infection in such cases.



Diversion Point from the Truckee Canal to Hazen Community Water Supply.

Cultural Resources

Assuming that the discharge pipeline (if required) would follow the river for no more than 2 miles (or about to Lockwood), and it would follow the preliminary route designed for the pipelines under Alternatives L-1, L-6 and L-7, one prehistoric site identified to date (26Wa2) which has National Register potential, could be disturbed by construction and/or maintenance of the pipeline.

Institutional Considerations

The discharge of wastewater to the Truckee River is institutionally bound to the NPDES permit issued by the NDEP through authority delegated by the EPA. This permit, which establishes the maximum flow volume, effluent constituent limitations, monitoring, and other operational requirements, must assure that the Master Project will not violate Truckee River water quality standards. These standards are established by the State Environmental Commission and subsequently approved by the governor and the EPA regional administrator (Appendix C). The JWPCP is now operating under an interim NPDES permit (Chapter 2) and a final Master Project permit has not been developed at this time.

The impact of this alternative on the NDEP and the EPA in the establishment of a permit is expected to be significantly influenced by the Endangered Species Act, Section 7 proceedings. Grant conditions affecting the content of the NPDES permit may result from Section 7 consultations between the EPA and the USFWS on a "biological opinion" made by the USFWS.

Other governmental programs that may be affected by this action include the WCOG/RPC 208 program, the state implementation plan for air quality prepared by the WCOG and water conservation programs of the Cities of Reno and Sparks.

Implementation of the Master Project river disposal option is not expected to infringe on water rights, water litigations, or river water operations agreements. However, there is great uncertainty about projecting the institutional consequences of any project even secondarily affecting water flow in the Truckee River system (Appendix C).

Energy

The Facilities Plan (Kennedy/Jenks, 1980) contains insufficient data to quantify energy use of the Truckee River discharge alternative. This alternative involves a treatment process that is more energy intensive than the Truckee Canal or Dodge Flat alternatives. Disposal would be by gravity, which would use no energy.

Mitigation of Truckee River Disposal Impacts

- Ammonia, nitrite and nitrate toxicity may remain in the Truckee River below the outfall in October and November of low flow years.

This impact could be mitigated by revising flow criteria to allow flow management for water quality protection at low flows. This would involve allocation of upstream reservoir storage for such purposes, so that flow augmentation could be achieved in low flow periods. The institutional and legal ramifications of changes in flow management are complex, and implementation of this mitigation would be difficult.

Additional treatment for further nitrogen removal and control of toxicity would also be possible, although it would add to the cost. Postconstruction monitoring of the Truckee River below the discharge should be required to better define the magnitude of the problem and document the effectiveness of mitigation measures.

- TDS and salt loading to the Truckee River and Pyramid Lake will increase.

- Increased TDS may require greater irrigation application to flush salts from the root zone.

These two impacts could be mitigated by removing the discharge from the river; using a different treatment process that would not add salts to the effluent; removing part of the salts from the effluent prior to discharge, usually a costly and energy-intensive process; or by mitigating TDS contributions from another source on the Truckee River as a trade-off.

- Nitrogen and phosphorus standards will continue to be exceeded in low flow periods due to JWPCP discharge.

This impact can be mitigated by augmenting low flows through changes in river management, a difficult and complex action. It can also be mitigated by further treatment, which would increase project costs, or through removal of the discharge from the river.

- The Truckee River temperature could be raised by up to 2.3°C (4.1°F) by the outfall.

This impact can be mitigated by cooling the effluent prior to discharge, an energy-intensive and costly process. It can also be partly mitigated by diffusing the effluent over a longer reach of the Truckee River. Monitoring of actual temperature changes should be required.

- JWPCP pollutants will continue to enter and accumulate in Pyramid Lake, posing a long-term threat to the endangered cui-ui.

This impact can be mitigated by further treatment, including reduction in TDS, and by removal of the discharge from the Truckee River. Long-term monitoring of nutrients should be continued to quantify changes due to the plant discharge and to determine if further mitigation is necessary.

- Public health risk to Hazen water supply users, and to other communities dependent on groundwater.

The public health threat to Hazen could be reduced by treating the water supply. The threat could be eliminated entirely by developing a new water source entirely free of effluent. For the other affected communities that rely on well water, treatment of the well water would help mitigate the threat. This impact could also be eliminated by removing the discharge from the Truckee River.

- Energy use would be highest for AWT plant.

This impact could be reduced by using a less energy-intensive treatment process, or only providing secondary treatment and removing the effluent discharge from the Truckee River.

Impacts of Land Disposal at Dodge Flat
(Alternatives L-6 and L-7)

The facilities needed to achieve disposal at Dodge Flat include modification of the ESP, phosphorus removal facilities, and the addition of new facilities to bring the plant capacity to 40 mgd of secondary treatment. Chlorinated effluent would be converged by gravity through 133,000 feet of pipeline located adjacent to the Truckee River to a reservoir on Dodge Flat. Sludge would be piped to Spanish Springs Valley and disposed of by spreading on the land. In the case of Alternative L-6, stored effluent would be pumped during the growing season to center pivot irrigation sprinklers to irrigate 4,200 acres of forage crop. During the winter the effluent would be spread on land in Olinghouse Canyon to evaporate and percolate into the subsurface aquifer. In Alternative L-7 effluent would be turned into the Fernley drain during the nonirrigation season.

The reuse of wastewater to grow agricultural crops typically offers potential cost and renewable natural resource benefits, especially in arid regions such as Nevada. Potential cost benefits are usually associated with the need for less complex and thus lower cost treatment plants. Renewable resource benefits in arid areas generally are linked to water conservation in that irrigation water supply is either augmented or released for another type of beneficial use. Moreover, soil filtration is viewed as an optimum form of wastewater treatment in situations where groundwater will not be degraded. The general benefit may apply over the 20-year planning period to the Dodge Flat Alternatives (L-6 and L-7). Several benefits have been identified that apply in particular to land disposal at Dodge Flat.

- Removes the Reno-Sparks JWPCP wastewater discharge from the Truckee River.
- Improves water quality and fish habitat quality downstream of Steamboat Creek to a condition where water quality would not be a significant impediment to a productive fishery.
- Improves the opportunity for recovery of the cui-ui and Lahontan cutthroat trout insofar as water quality problems caused by the JWPCP are corrected.
- Develops a technologically up-to-date agricultural operation that would provide new employment and revenue to the Paiute Indian Tribe.
- Improves opportunities to develop the Truckee River and Truckee Canal for multiple recreational uses to serve the future urban population.

- Significantly reduces the input of potential pollutants to Pyramid Lake, resulting in a reduction in the rate of eutrophication of the lake.

- Significantly reduces the input of nutrients and other potential pollutants into Lahontan Reservoir, which is expected to reduce algal blooms and mitigate a decreased DO problem.

- Requires standard secondary wastewater treatment of proven reliability and efficiency.

- Lower operations and maintenance requirements:

  a) labor skills
  b) cost
  c) chemicals
  d) energy

These potential benefits are offset by a number of disadvantages which are identified in the following text.

The impacts of Dodge Flat land disposal encompass Truckee River flow reduction, potential water quality changes, reduction of water available to beneficial uses, institutional ramifications, and air quality impacts. These effects are discussed in this section, with the emphasis on flow reduction effects and water quality changes.

Surface Hydrology

The effects of Dodge Flat disposal on surface hydrology are primarily as follows, as compared to a base case of Truckee River disposal:

- Reduces mean annual flow from Vista to Derby Dam by 8 percent, and reduces inflow to Pyramid Lake by 9 percent.

- Reduces low Q_{10} flows by up to 65 percent at Vista and Derby Dam and up to 73 percent at Pyramid Lake inlet.

- Decreases spills from Lahontan Reservoir by 2-4 percent.

- Increases the risk of M&I deficits slightly, and substantially increases the risk of Newland Project deficits.

The Dodge Flat land disposal option (called land disposal in these analyses) removes water from the Truckee River and utilizes evaporation at Dodge Flat, thus reducing the total volume of water available for other beneficial uses. Through study with the computer model, it is estimated that this reduction represents a reduction in the mean annual flow at Vista of about 8 percent, compared to Truckee River discharge, and a reduction in mean annual flow into Pyramid Lake of about 9 percent. These figures assume no return flow from Dodge Flat to the Truckee River. With rapid infiltration (Alternative L-6) return flows could begin within 10 years, reducing these depletions.

These annual flow reductions would occur at various rates throughout the year, but would be most pronounced during the once in 10-year mean low monthly flow periods (low Q_{10} flow). During periods of low flow, upstream storage is likely to be depleted sooner since the JWPCP effluent would no longer be available to help meet downstream water demands. As a result, the monthly low Q_{10} flow could be reduced by up to 65 percent at Derby Dam and up to 73 percent at the inlet to Pyramid Lake. Most of the year these reductions are less than 20 percent. The extent of impact on low Q_{10} flows varies month to month, and varies somewhat in response to the future river operating criteria assumed for the analysis. Table 4-4 in Chapter 4 presents a complete summary of the month-by-month effects by principal location on the river.

The reduction in flows will adversely affect water quality, particularly in low flow events, by reducing the flow available to dilute background loads. Recreational uses will be adversely affected by reduced flow and impaired quality. Fish may also be adversely impacted by such changes.

The disposal of the effluent at Dodge Flat essentially creates a large agricultural competitor for irrigation water in the Truckee basin, and confers on it a higher priority for water than that accorded the Newlands Project. As a result, the risk of shortage in irrigation water to the Newlands Project will rise. Shortages historically have occurred in the Newlands Project, principally during droughts. The land disposal option is estimated to increase shortages by 66 to 71 percent over what they would be under river disposal (see Table 4-10).

The risk of municipal and industrial water supply shortages under land disposal would be slightly greater than under river disposal, but only under the most severe drought periods.

The land disposal option raises additional issues regarding water use in the Truckee and Carson River basins. Among these is the issue of the largely unexercised water right held by the Pyramid Lake Tribe of Paiute Indians.

If the Indians were to exercise their full water right of over 30,000 acre-feet per year, a different baseline case for evaluation of impacts would be created. In effect, the presently undiverted 26,500 acre-feet per year of this Indian right are presently going to other beneficial uses in the Truckee and Carson basins, including M&I, agriculture, and fish and wildlife. Even though part of the right is unexercised, the water does exist and does flow in the Truckee River system. Since the Indian right has one of the highest priorities on the river, it could displace other uses if fully exercised, depending on water availability. This competition between users could become most pronounced during dry years. The Newlands Project would likely be the focus of such a conflict, since a greater portion of the flow arriving at Derby Dam would at times have to be passed to the lower Truckee River, thereby reducing diversions into the Truckee Canal.

Land disposal could have a marked impact on this competition between users. If the tribe exercises its full diversion right under Truckee River or Truckee Canal disposal, the total consumptive use (depletions to the Truckee River) would be about 20,000 AFY at 67 percent efficient irrigation. Under Dodge Flat land disposal, however, the consumptive use would be 42,000 AFY, since no return flow would be allowed. The Indian tribe would be guaranteed the full amount of their right to 30,000 AFY plus an additional 12,000 AFY for a total 42,000 AFY. These calculations assume that the effluent would totally replace the existing 3,500 AFY Truckee River diversion below Derby Dam from which return flows now occur. Otherwise diversions and depletions would be greater.

The depletions in water in the basin are demonstrably larger with land disposal than for the other alternatives, even if the Indian water right is fully exercised. The comparison between alternatives, however, assumes present levels of tribal diversion (3,500 AFY). The comparisons between Truckee River, Truckee Canal, and Dodge Flat disposal would be altered if a base case with full exercise of tribal rights were assumed. Under that assumption, the relative differences in flow depletions under land disposal would be less pronounced relative to the Truckee River and Truckee Canal disposal options indicated herein. Since no scenarios were mathematically modeled for the assumption that the tribal right would be fully exercised, no further numerical analysis is attempted.

The hydrologic analyses presented in Chapter 4 treat the JWPCP-induced flow changes as occurring against a background of two or three different sets of river management criteria. These criteria reflect alternative basic assumptions developed in response to competing demands and complex institutional arrangements. The analyses do not attempt to predict any changes in river management that might be necessary for or precipitated by expansion of the JWPCP and changes in effluent disposal. In fact, the plant expansion, coupled with prospective changes in disposal methods, may be a catalyst for change or attempts to change certain management methods of the Truckee River system.

Specifically, the effects on mean annual flows, low Q_{10} flows, and Newlands Project shortages may prove to be a powerful stimulant in initiating changes in river management. One effect of such efforts would be to further complicate the institutional relationships through new litigation, the outcome of which, in terms of revised flow estimates, is totally unpredictable.

Water Quality

The effects of land disposal at Dodge Flat on water quality are described as follows, assuming no return flow from Dodge Flat.

- Elimination of toxicity from Truckee River due to chlorine, ammonia, nitrite and nitrate.
- Reduction of river flow causing increased non-point source pollutant concentrations between JWPCP outfall and the inlet to Pyramid Lake. Most critical in low Q_{10} flows, when up to 65 or 73 percent of diluting flow could be absent.
- Enables better identification and mitigation of remaining pollutant sources.
- Algal growth potential in the Truckee River and Truckee Canal will be greatly reduced.
- DO concentrations would be higher.
- Other water quality parameters would be improved.
- Threats to quality and beneficial uses of Pyramid Lake would be reduced.
- Lower lake level due to loss of 9 percent of inflow would increase TDS.
- Improvement of Lahontan Reservoir quality, with increased opportunity to optimize beneficial uses.

Truckee River

The main disadvantage to Truckee River water quality of land disposal would be the loss of a portion of flow of the river downstream from Vista, thereby reducing the volume of flow available for diluting pollutant loads, particularly those loads entering the river in and below the Truckee Meadows. Consequently, most remaining disadvantages for water quality associated with land disposal relate to nonpoint sources of nutrients, solids, solutes, and heavy metals which are not resolved by the Master Project. A major water quality benefit stemming from the land disposal alternative is that any pollutants remaining in the river can be identified through monitoring and targeted for corrective action through the 208 program.

Under Alternative L-6, Dodge Flat irrigation with rapid infiltration of 22,000 AFY in Olinghouse Canyon, the effluent can return to the Truckee River by groundwater flow. This return flow could begin within 10 years. The analyses in this section are based on the no return flow situation, conditions under the first 5-10 years of Alternative L-6, and conditions during the life of Alternative L-7.

The rate of return flow to the Truckee River under Alternative L-6 is not readily predictable. A gradual increase in discharge to the river, with an ultimate equilibrium possibly approaching half of the total JWPCP discharge, is likely. Soil uptake of nutrients, and solution of old lake bed salts in the wastewater appear likely, although long-term equilibria are unpredictable. The accretions to the river are likely to be lower in nitrogen and phosphorus and higher in TDS and chloride than the applied effluent.

If return flow to the Truckee River is allowed to occur, many of the water quality benefits to the lower Truckee River and Pyramid Lake of Dodge Flat land disposal will be lost. At the outset of the studies it was assumed that no return flow would be allowed from Dodge Flat. The numerical flow analyses were accomplished under those assumptions and the water quality analyses are based on the predicted flows. Thus, no attempt is made to quantify the effects of the return flow that are now predicted based on information in the Facilities Plan (Kennedy/Jenks, 1980).

Under Alternative L-7, land disposal to Dodge Flat with winter discharge to the Fernley drain, the effluent may never enter the Truckee River. The quality of the Truckee River will then be the background quality indicated by PEL data (Table 5-20).

Comparing Table 5-20 with river water quality standards shows a slight exceedence of the total nitrogen standard.

Comparison of Table 5-20 with Table 5-7 shows the effect of the JWPCP. The tables illustrate average, rather than low Q_{10} flow conditions. As flow is reduced, pollutant concentrations will tend to rise. The low Q_{10} flows will be substantially lower for land disposal than for river disposal during dry periods, as discussed earlier. The potential therefore exists for more standards violations with land disposal than for Truckee River disposal during low flow periods.

Table 5-20. Estimated Concentration of Various Pollutants at the Confluence of the Truckee River and Steamboat Creek for a Mean Monthly Flow
(mg/l)

Dodge Flat Land Disposal, 406 Criteria

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual
Nitrate Nitrogen (NO_3-N)	.19	.20	.14	.09	.06	.08	.22	.24	.21	.23	.27	.24	.18
Nitrite Nitrogen (NO_2-N)	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
Ammonia Nitrogen (NH_4-N)	.05	.05	.04	.02	.02	.02	.06	.06	.06	.06	.07	.06	.05
Organic Nitrogen	.88	.93	.65	.43	.28	.35	1.00	1.10	.98	1.07	1.24	1.11	.84
Total Nitrogen	1.12	1.18	.82	.55	.36	.45	1.27	1.39	1.24	1.36	1.57	1.41	1.06
Orthophosphate Phosphorus (O-PO_4-P)	.02	.03	.02	.01	.01	.01	.03	.03	.03	.03	.03	.03	.02
Total Phosphorus	.05	.05	.03	.02	.01	.02	.05	.06	.05	.06	.07	.06	.04
Chloride	6.72	7.08	4.93	3.29	2.15	2.68	7.63	8.35	7.46	8.18	9.43	8.43	6.19
Total Dissolved Solids	80	80	60	40	20	40	100	100	100	100	120	100	78
Biochemical Oxygen Demand	1.14	1.20	.83	.56	.36	.45	1.29	1.41	1.26	1.38	1.59	1.42	1.07

Dodge Flat Land Disposal, 288 Criteria

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual
Nitrate Nitrogen (NO_3-N)	.19	.17	.12	.08	.06	.08	.19	.27	.31	.31	.27	.24	.19
Nitrite Nitrogen (NO_2-N)	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
Ammonia Nitrogen (NH_4-N)	.05	.04	.03	.02	.02	.02	.05	.07	.08	.08	.07	.06	.05
Organic Nitrogen	.90	.79	.58	.36	.28	.35	.90	1.25	1.45	1.43	1.25	1.11	.88
Total Nitrogen	1.14	1.00	.73	.46	.35	.45	1.15	1.59	1.84	1.81	1.59	1.41	1.13
Orthophosphate Phosphorus (O-PO_4-P)	.02	.02	.02	.01	.01	.01	.02	.03	.04	.04	.03	.03	.02
Total Phosphorus	.05	.04	.03	.02	.01	.02	.05	.07	.08	.08	.07	.06	.05
Chloride	6.86	6.01	4.39	2.75	2.11	2.69	6.88	9.52	11.01	10.86	9.52	8.43	6.75
Total Dissolved Solids	80	80	60	40	20	40	80	120	140	140	120	100	85
Biochemical Oxygen Demand	1.16	1.02	.74	.47	.36	.46	1.16	1.61	1.86	1.84	1.61	1.42	1.14

DATA SOURCE: Jones & Stokes Associates, Inc., and DRI, 1980; PEL, 1979.

Land disposal of the JWPCP effluent will greatly reduce AGP in the river. From data collected by DRI, the background AGP (above Steamboat Creek) is small.

This low AGP should prevail over the entire length of the Truckee River, including the Truckee Canal. Algal growth may increase slightly below Derby Dam from nutrient inputs from agricultural sources in this reach, but this would be unrelated to the JWPCP operation. However, if return flows from Dodge Flat reach the river, nutrient and TDS influx is expected.

Without return flows, the biomass of algae and other life forms (Aufwuchs) that are now observed on rocks and gravels in the river would be significantly reduced. Reductions in periphyton growth would secondarily improve other features of river bottom habitat. Chief among these being higher concentrations of DO in the sediment matrix. Because of nonpoint source nutrient inputs from Truckee Meadows, the downstream reach would not be as free of algae as upstream reaches, but the present condition should be significantly improved.

The background load present at Reno passes downstream with additions only from Steamboat Creek and the north Truckee drain. The estimated concentrations of pollutants at Vista under canal disposal are shown in Table 5-21. Again, there is a slight exceedence of the total nitrogen standard for the average annual condition.

Pyramid Lake. The removal of the JWPCP effluent from the Truckee River would greatly reduce any potential for Reno-Sparks municipal sewage to impair the quality and beneficial uses of Pyramid Lake. There would remain the risk associated with a rupture of the outfall pipeline from the JWPCP to Dodge Flat. A pipeline rupture could release substantial quantities of secondarily treated wastewater to the river and subsequently Pyramid Lake. Impacts of this nature would be relatively short-term catastrophes, and probably of minor long-term significance to the lake.

There is also the risk that return flows from Dodge Flat (likely within 10 years under Alternative L-6) would offset many of the expected benefits of land disposal.

The current total nitrogen load to Pyramid Lake is about 3,781 pounds per day (Table 5-4). The total nitrogen load discharged to the lake with full operation of the 30 mgd ESP would be about 5,593 pounds per day which would be reduced to a background load of 2,055-2,739 pounds per day using land disposal and also depending on the TCID operating criteria. Substantial reductions in the total nitrogen load

Table 5-21. Estimated Concentration of Various Pollutants in the Truckee River at Vista for Calculated Mean Monthly Flows (mg/l)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual
Truckee Canal Disposal, 406 Criteria													
Nitrate Nitrogen (NO_3-N)	.19	.20	.14	.09	.06	.07	.22	.26	.22	.23	.27	.23	.18
Nitrite Nitrogen (NO_2-N)	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
Ammonia Nitrogen (NH_4-N)	.05	.05	.04	.02	.02	.02	.06	.07	.06	.06	.07	.06	.05
Organic Nitrogen	.87	.92	.64	.43	.28	.35	1.03	1.22	1.03	1.09	1.24	1.08	.85
Total Nitrogen	1.11	1.17	.81	.54	.35	.44	1.31	1.55	1.31	1.38	1.57	1.38	1.08
Orthophosphate Phosphorus (O-PO_4-P)	.02	.03	.02	.01	.01	.01	.03	.03	.03	.03	.03	.03	.02
Total Phosphorus	.05	.05	.03	.02	.01	.02	.05	.06	.05	.06	.07	.06	.04
Chloride	6.66	6.99	4.88	3.24	2.12	2.65	7.87	9.30	7.86	8.30	9.43	8.26	6.46
Total Dissolved Solids	.04	.04	.03	.02	.01	.02	.05	.06	.05	.05	.06	.05	.04
Biochemical Oxygen Demand	1.13	1.18	.83	.55	.36	.45	1.33	1.57	1.33	1.40	1.59	1.40	1.09
Truckee Canal Disposal, 288 Criteria													
Nitrate Nitrogen (NO_3-N)	.19	.20	.12	.08	.06	.08	.21	.31	.31	.30	.27	.24	.20
Nitrite Nitrogen (NO_2-N)	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
Ammonia Nitrogen (NH_4-N)	.05	.05	.03	.02	.02	.02	.05	.08	.08	.08	.07	.06	.05
Organic Nitrogen	.88	.91	.58	.36	.27	.35	.97	1.46	1.43	1.37	1.25	1.11	.92
Total Nitrogen	1.12	1.16	.73	.46	.35	.44	1.23	1.85	1.81	1.74	1.59	1.41	1.16
Orthophosphate Phosphorus (O-PO_4-P)	.02	.03	.02	.01	.01	.01	.03	.04	.04	.04	.03	.03	.03
Total Phosphorus	.05	.05	.03	.02	.01	.02	.05	.08	.08	.07	.07	.06	.05
Chloride	6.71	6.94	4.40	2.76	2.07	2.66	7.38	11.10	10.88	10.45	9.54	8.43	6.94
Total Dissolved Solids	.04	.04	.03	.02	.01	.02	.04	.07	.07	.06	.06	.05	.04
Biochemical Oxygen Demand	1.13	1.17	.74	.47	.35	.45	1.25	1.88	1.84	1.77	1.61	1.42	1.17

DATA SOURCE: Jones & Stokes Associates, Inc., DRI, 1980; PEL, 1979.

would occur, which should in the long run reduce any trend toward undesirable levels of eutrophication. Data and models are not available to project the quantitative benefits of a possible 46 percent reduction in total nitrogen load.

Irrigation of 4,200 acres at Dodge Flat is expected to cause some accretion of groundwater from the irrigated area to the lower Truckee River and then to Pyramid Lake, particularly under Alternative L-6. Salts leached from the irrigated soils will add an undetermined amount of solutes to Pyramid Lake. Nitrate is expected to be a component of the solute; however, the quantity is undefined. The amount of nitrogen reaching the groundwater will depend to a large extent on how the irrigation system is operated.

The presently proposed land disposal alternatives (L-6 and L-7) would result in a significant reduction (9 percent) in the average annual inflow into Pyramid Lake. If no action is taken to compensate river flow for the diversion of up to 42,000 acre-feet of effluent to the land, the average annual river inflow to Pyramid Lake could be diminished by almost this amount.

Over the long-term, any reduction in annual inflow exacerbates the problem of stabilizing and reversing the trend of lowering the lake level, which began in 1906. The magnitude of a 9 percent inflow reduction on a stabilized lake elevation has not been computed. General problems associated with the lowered lake elevation are discussed in Chapter 4. The recreational and economic value of the lake has been impaired by the drop in elevation.

Fish and wildlife habitat in the lake has been diminished. Lowering of the lake and the creation of an extensive silt delta at the mouth of the Truckee River has directly contributed to the endangerment of the cui-ui and the extinction of the original Pyramid Lake population of cutthroat trout.

Other factors could serve to mitigate the maximum effect, e.g., the change in location of use of water rights now being exercised on other lands to Dodge Flat; however, methods to mitigate the diminished inflow to the lake are not included in the Facilities Plan.

Truckee Canal

The land disposal option will leave only the background pollutant load of the Truckee River at Derby Dam to be diverted into the Truckee Canal, and the remainder released to the lower river.

Once in the canal the background pollutants will be acted upon by physical and chemical processes and also be subject to direct diversion or seepage from the canal. The pollutant load at the terminus of the Truckee Canal will be the original pollutant load, reduced by losses due to diversion and seepage, and modified by physical and chemical processes.

Relative to the present and the ESP conditions, land disposal will improve the quality of the Truckee Canal. The pollutant load at Clark, especially nutrients, will be greatly reduced from current levels.

The disposal of effluent on land will also have an enhancement effect upon the quality of the Truckee Canal. For the long-term average flow condition in the canal, the pollutant load diverted at Derby Dam is less under land disposal than the present river disposal. Tables 5-17 and 5-18 show the pollutant load for total nitrogen, total phosphorus, chloride and TDS under average annual conditions at the head of the canal and of its terminus.

Beneficial uses of the Truckee Canal and groundwater recharged from the canal would be enhanced by implementation of the land disposal alternatives. The water supply at Hazen would noticeably improve in quality, lower risk to public health, and increase aesthetic appeal. The NDW supports a seasonal trout fishery and associated recreation for the canal. These opportunities would be enhanced by land disposal. Affects on shallow aquifers being recharged by the canal may not show noticeable improvement, because these aquifers are also recharged by percolating irrigation water.

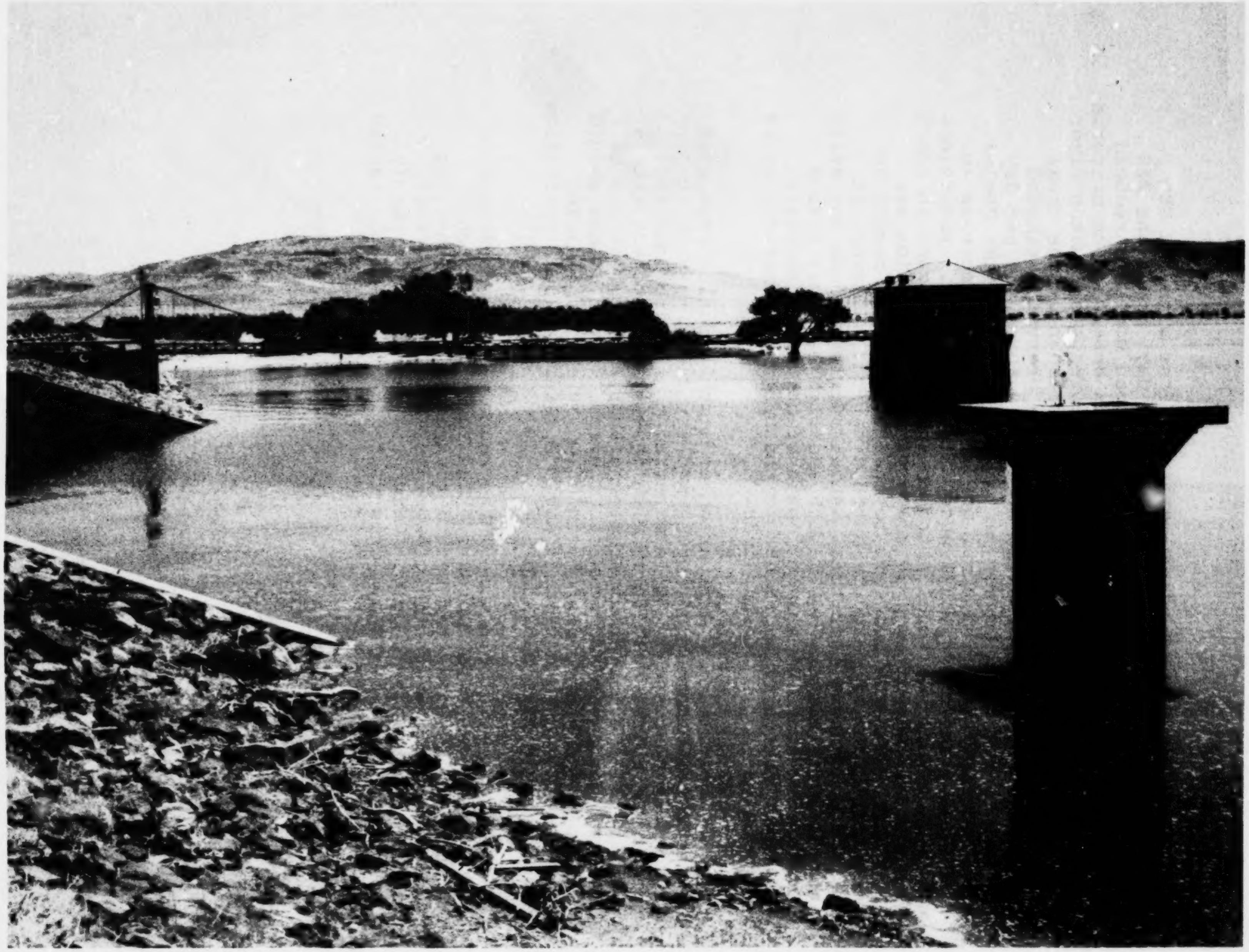
Lahontan Reservoir. Land disposal (Alternatives L-6 and L-7) could have an effect on the amount of water reaching Lahontan Reservoir, because at 40 mgd operations up to 60 cfs would be diverted from the river upstream of Derby Dam. This water now reaches Derby Dam where it either passes the dam or enters the Truckee Canal. Although increased water shortages to the Newlands Project would occur under this alternative, no data are available to suggest how reduced diversions could be accommodated by downstream flow demands and the operation of Lahontan Reservoir.

The average annual loads to the reservoir of selected potential pollutants for land disposal are given in Table 5-4 in the river disposal section. This alternative provides the largest benefits for Lahontan Reservoir, because waste loads originating from the JWPCP do not reach the reservoir. Certainly, enhanced water quality improves the opportunity to maximize the value of its beneficial uses (see Chapter 4, Lahontan Reservoir).

The average annual total nitrogen load with the ESP is estimated to be 710-2,183 pounds per day, under the 288 and 406 criteria, respectively. This load would be reduced to 283-742 pounds per day total nitrogen depending on criteria (Table 5-4). The load in this case represents Truckee River background conditions, i.e., no JWPCP effluent. The total phosphorus load would be reduced from a present estimated 468 pounds per day to the ESP load of 19-60 pounds per day and finally to 12-32 pounds per day under the Master Project. Areal loadings from the canal are estimated to decrease to 0.03-0.08 grams/m^2/yr total phosphate-phosphorus. Reductions of 85-62 percent in total nitrogen and 97-93 percent in total phosphorus loads after 1-20 years of plant operation are thought to maximize benefits to the reservoir in regard to beneficial uses affected by eutrophication. However, it must be recognized that total annual nutrient loads may still increase with time as the Carson and Truckee River basins develop and nonpoint source inputs of nutrients increase. The major source of nutrients to the Lahontan Reservoir would continue to be the Carson River.

Any quantitative evaluation of limnological change must await the development of models and verification data as previously mentioned. It is expected that reductions in nutrient loadings associated with this Master Project alternative will provide significant and substantial benefits to Lahontan Reservoir and downstream users. Algal blooms should decrease in density, depression of DO in the hypolimnion should diminish, and fishing and other recreational activities should become more pleasing.

The potential for use of the reservoir as a domestic water supply will be improved. The removal of the JWPCP effluent from the system should reduce public health risks and unfavorable aesthetic viewpoints about the reservoir as a drinking water supply. Water treatment will probably be required on a seasonal basis to reduce unacceptable tastes and odors associated with algae.



Lahontan Reservoir at the Dam Face.

Institutional Considerations

Indirectly, implementation of the land disposal alternative may affect the amount of water reaching Lahontan Reservoir. It is assumed that an alteration in the amount or schedule of diversions into Truckee Canal may be required to accommodate the eventual diversion of 48,800 AFY to Dodge Flat. No information was found to suggest how the diversion would be implemented relative to downstream water rights and contracts.

Fish and Wildlife

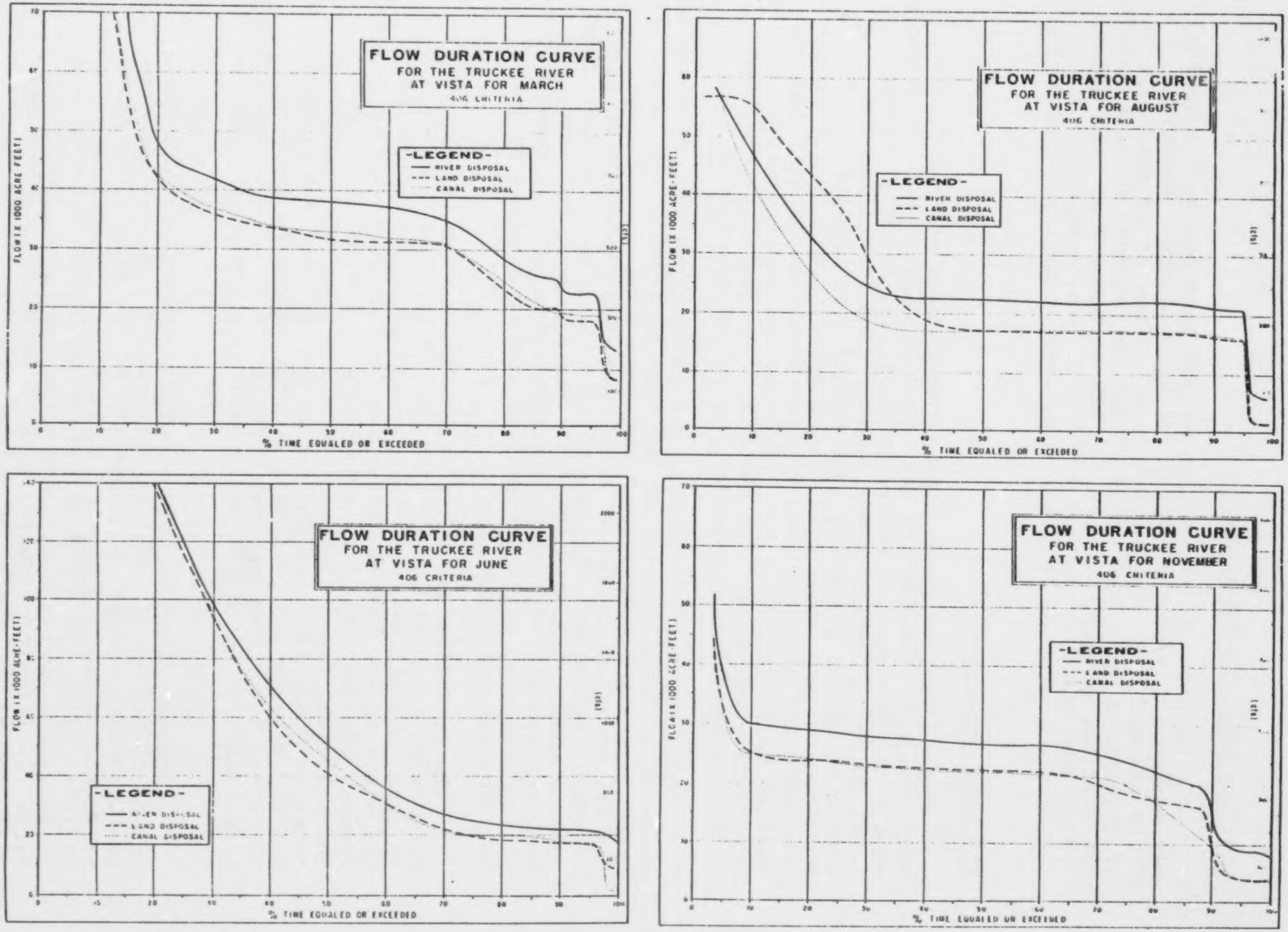
Fish. Habitat conditions as they occur through full utilization of the ESP are described in Chapter 4. The environmental consequences of Master Project land disposal alternatives on hydrology and water quality were identified and discussed in the preceding sections of this chapter. Implementation of the Dodge Flat land disposal option would remove the JWPCP effluent from the Truckee River and greatly improve habitat conditions for fish and other aquatic organisms. Thereafter, any impacts of the Master Project on river water quality would be of a secondary or accidental nature.

Until about 1960, rainbow and brown trout supported a popular recreational fishery in the Truckee River between Reno and Derby Dam. In recent years toxic conditions seem to have, for all practical purposes, destroyed this fishery. It is expected that trout, whitefish, and other pollution-sensitive species would again use the river between Reno and Derby Dam, the lower river, and the Truckee Canal during times of the year when water temperature and stream flow support such species use.

The land disposal option does have direct and significant effects on instream flow, which can impair fish habitat (Figures 5-3 and 5-4). In comparison to alternatives that discharge to the Truckee River the land disposal option generally reduces the instream flow downstream of Steamboat Creek. The relative effect of this reduction on average monthly flows at Vista is about 15-20 percent with the 406 criteria, which may be less significant to fish production between Vista and Derby Dam than the benefits to the fishery of improved water quality. Data are not available to quantify such tradeoffs.

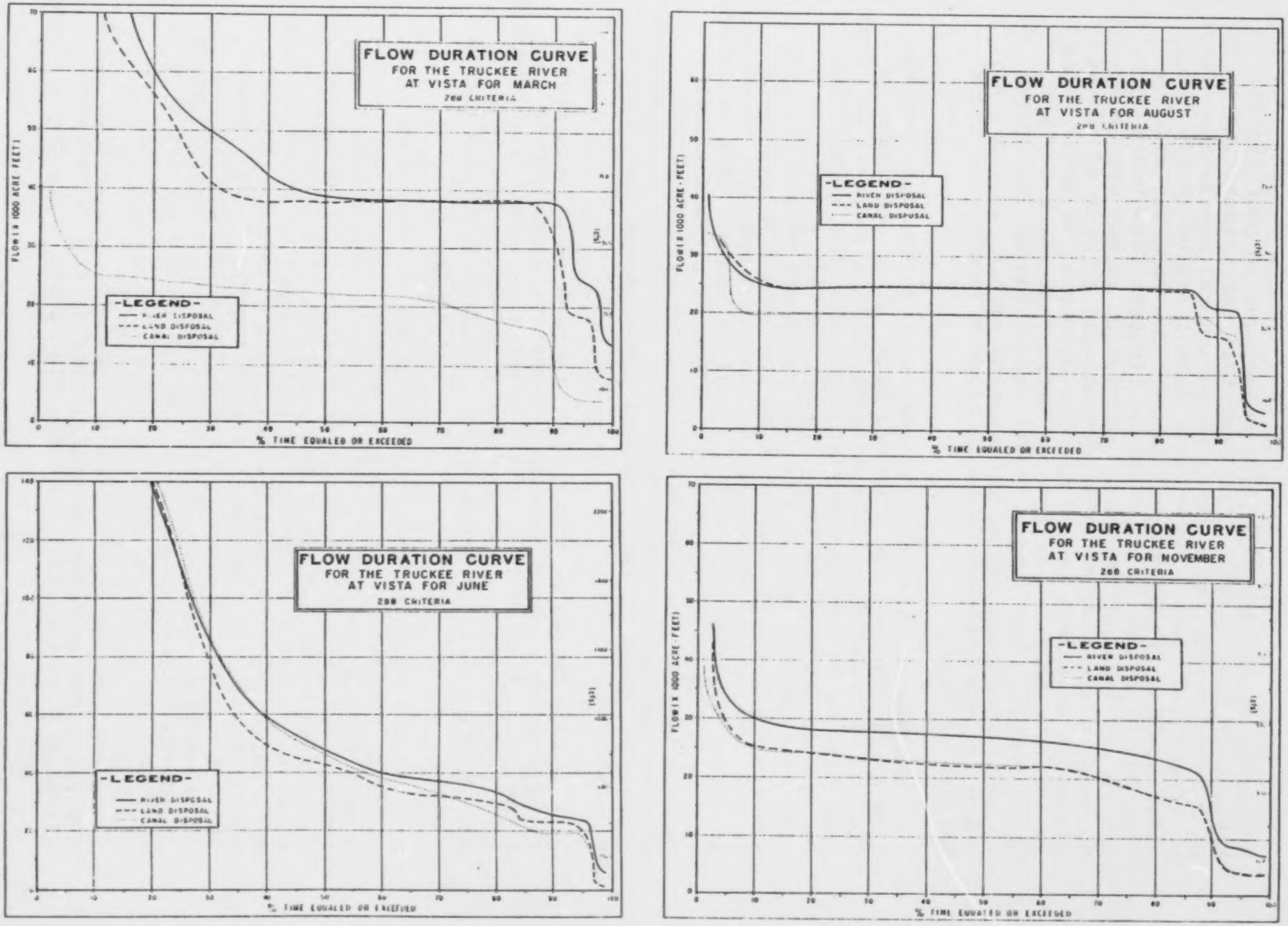
Instream flow depletions during 1-in-10-year low flows may be deemed significant in October and November when the instream flow may be 35-53 percent of the historical flow at Vista and Derby Dam. For example, a Q_{10} low flow in October at Vista of 88 cfs could be reduced to 31 cfs. Reductions during these months would seem to be most significant for brown trout reproduction, although the overall amount of fish habitat would also be reduced. Data were not

Figure 5-3. Average Monthly Flow Duration Curves for Vista at the 406 Scenario Operating Criteria



SOURCE: Jones & Stokes Associates

Figure 5-4. Average Monthly Flow Duration Curves for Vista at the 288 Scenario Operating Criteria



SOURCE: Jones & Stokes Associates

available to convert such flow reductions to quantitative habitat or fish losses. The fact that such reductions occur on a 1-in-10-year basis tends to lessen the cumulative effect on long-lived fish. The average annual inflow in the lower river would be reduced 8-9 percent. The absolute effects of a 60 cfs reduction at Vista on instream flow below Derby Dam is undetermined, because information is not available to indicate from which water demands all or part of the 60 cfs would be subtracted from. The diversion of water among uses is a complex reflection of water-year, storage, and water demand. The land disposal option causes the system to incur shortages for meeting demand earlier in the year, which reduces instream flows to minimum levels over longer periods of time.

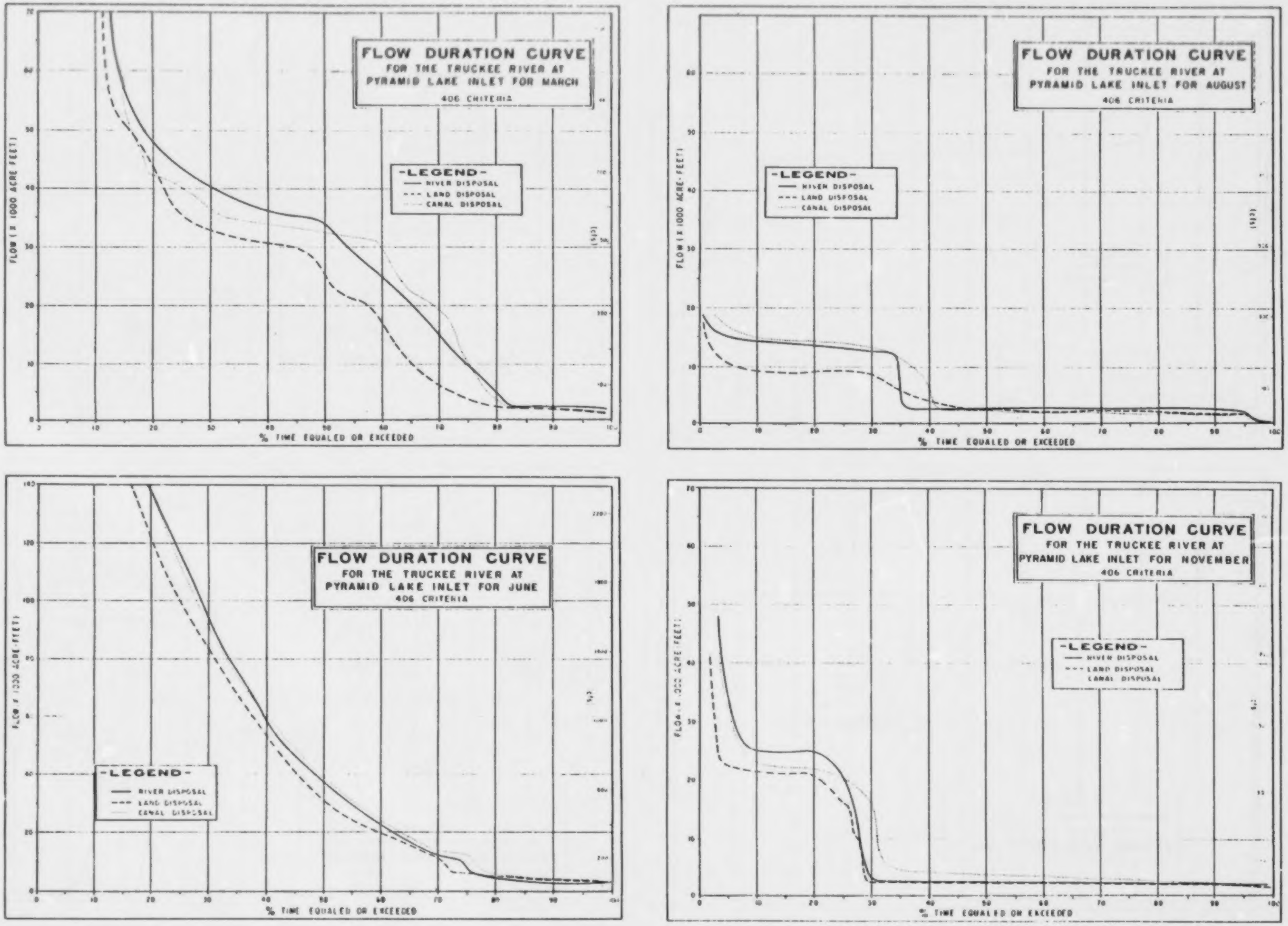
The 406 and 288 scenario analyses of four mean monthly flow durations at Nixon (Pyramid Lake inlet) are shown in Figures 5-5 and 5-6 . The effects of land disposal on long-term flow conditions are variable and probably significant to aquatic habitat and fish. Using the 406 criteria as a case example, the median flow for March may be reduced from about 540-400 cfs by implementing the land disposal option. In the case of the 288 criteria, the March median flow would increase from about 550-600 cfs. It is assumed that variations in flow of these magnitudes can influence the migrations of fish between the lake and river. The precise effects of flow alterations would have to be determined using methods similar to those of the USFWS PHABSIM instream flow analyses program.

Low Q_{10} flows at Nixon could be reduced to less than 50 percent of river discharge alternative flows (Table 4-4). Large reductions in flow in the lower river could significantly affect the migratory movements of fish between the river and Pyramid Lake and decrease fish production in the stream channel.

Fish passage at the river delta has already been significantly damaged by low river flow, resulting in the compensatory Marble Bluff fish facility. It is assumed that any further reduction in instream flow is a significant impact on fish passage between the river and lake. The information in Figure 5-5 and 5-6 and Table 4-4 illustrates potential relative changes in instream flow for land disposal. There is considerable variation in effect at low Q_{10} flows between the 406 and 288 criteria. The quantitative significance of these flow reductions to fish is uncertain and additional field and computer analysis would be needed to quantify effects on fish.

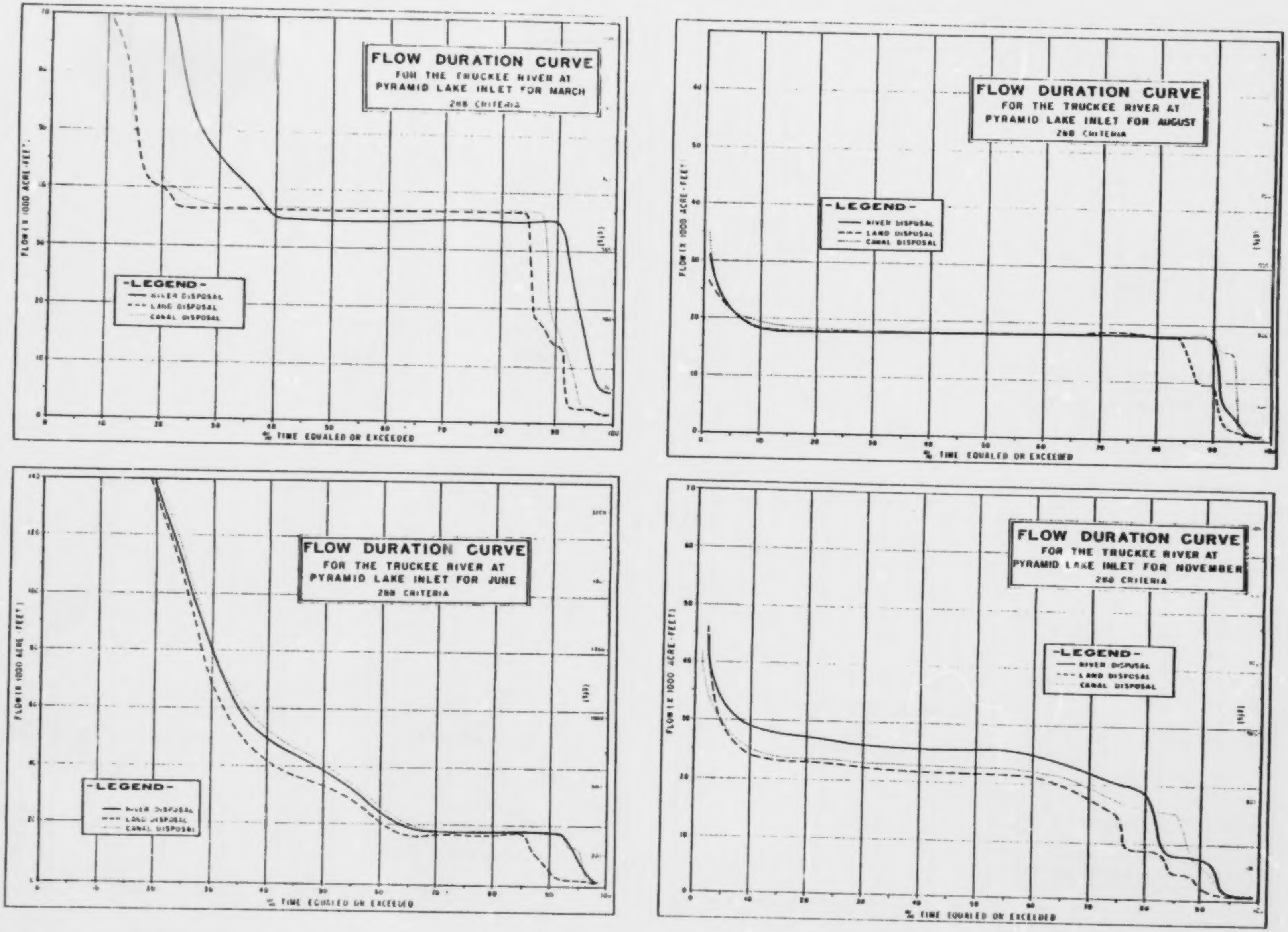
Accidents or natural catastrophes that rupture or block the pipeline conveying secondary treated and chlorinated effluent from the JWPCP to Dodge Flat could cause the effluent

Figure 5-5. Average Monthly Flow Duration Curves for Nixon (Pyramid Lake Inlet) at the 406 Scenario Operating Criteria



SOURCE: Jones & Stokes Associates

Figure 5-6. Average Monthly Flow Duration Curves for Nixon (Pyramid Lake Inlet) at the 288 Scenario Operating Criteria



SOURCE: Jones & Stokes Associates

to enter the Truckee River and Truckee Canal. Discharges to the river could cause fish kills, the magnitude of which would depend on circumstances such as size and duration of spill, season, river flow and diversion at Derby Dam. Catastrophic events are typically self-healing with time.

Wildlife. An arid sagebrush plain would be converted to 4,200 acres of irrigated land, roads, a 1,000 acre-foot storage reservoir and ranch support facilities. Animal species now using the natural habitat would be displaced and many would die within a short period of time. Species adaptable to irrigated agriculture may increase in numbers. The creation of new habitat types should attract species to the area that are not now there. Locally the impact on wildlife would be significant, but on a regional basis the impact would be minimal. No endangered wildlife are reported to be using the impacted area.

Endangered Fish - Cui-ui. Reductions in flows in the river downstream of Derby Dam and especially at the mouth of the river are potentially harmful to the cui-ui and adversely affect USFWS plans for the recovery of this endangered species. Based on the age groups of of cui-ui in Pyramid Lake, it is evident that reproduction success is greatest when flow from the river to the lake during the spawning and dispersion period is largest. Reductions in flows between March and May could reduce spawning activity and the survival and transport of larval fish back to the lake. The USFWS is presently investigating these features of the cui-ui life history (Appendix I).

The annual decrease of about 9 percent in inflow to Pyramid Lake could exacerbate the problem of cui-ui passing from the lake to the river by retaining the lake at a lower elevation.

Reductions in Truckee River flow also have the potential to reduce the amount of rearing habitat in the lower river and to affect ambient water temperature and water quality. Field studies would be required to test the significance of the effects of potential changes in instream flow on the habitat of particular cui-ui life stages and activities.

Threatened Lahontan Cutthroat Trout. Although Lahontan cutthroat trout do not now complete a natural life cycle involving Pyramid Lake and the Truckee River, it is a goal of the USFWS (1979) to restore the fish to its natural habitat. One of several habitat features that must be improved to achieve this goal is to increase the instream flow in the lower Truckee River and to abate water quality problems that would impair opportunities for this trout to complete its life cycle. Implementation of the land disposal option would abate those limiting water quality problems caused by the discharge to the river of treated wastewater from the JWPCP.

Toxicity from sewerage sources should no longer be present in the river. Spawning habitat between Vista and Derby Dam should improve through the abatement of excessive nutrient enrichment, and during years when water temperatures are sufficiently low during the spawning and rearing season, trout reproduction may successfully occur.

Flow reductions associated with the land disposal option may offset some of the benefit of improved water quality. Flow reductions in both the Vista to Derby Dam and lower reaches of the river (Figures 5-3 to 5-6) offer the potential to impair trout migration and diminish spawning habitat. Quantification of any effects caused by the scenario level flow reductions would have to be determined by field analysis.

The abatement of water quality problems in the river caused by the JWPCP, and the maintenance of present levels of river flow will, without other habitat improvements, not cause the Pyramid Lake population of Lahontan cutthroat trout to use the improved river habitat. Recovery of the species to a natural, reproductive state would require numerous additional habitat improvements (USFWS, 1979).

Groundwater

Irrigation of lands at Dodge Flat with effluent will adversely affect groundwater quality and beneficial uses of groundwater in that area. In order to prevent salt build-up, sufficient irrigation water will have to be applied to periodically flush these salts through the root zone. An increase in TDS, nitrates and other conservative substances will likely occur in the underlying groundwater.

Rapid infiltration of 22,000 AFY in Olinghouse Canyon on the western boundary of Dodge Flat (Alternative L-6) will substantially and adversely affect the groundwater basin in the Dodge Flat area. Percolated effluent will probably move toward the east under Dodge Flat, eventually developing a sufficiently high water table to discharge to the Truckee River. Based on geologic profiles developed by Cooper and Associates, the infiltrated water could occupy sufficient storage volume in the aquifer to begin discharge to the Truckee River within 10 years.

Such a discharge of groundwater could have a significant adverse effect on Truckee River water quality. Much of the pollutant loading of the JWPCP, less crop uptake and soil uptake, would return to the Truckee River, degrading water quality and increasing salt loading to Pyramid Lake.

It is expected that percolating effluent under either Alternative L-6 or L-7 will adversely affect water wells in and near Wadsworth, and will increase pollutant levels, particularly nitrate, above federal drinking water standards. It is expected that these effects will be much more rapid under Alternative L-6, rapid infiltration.

Discharge of 22,000 AFY to the Fernley drain (Alternative L-7) will affect groundwater quality in the vicinity of the drain and in the Fernley Game Management Area. It is possible that infiltration could adversely affect beneficial use of the shallow aquifers in this area.

Water Supply

As discussed in the preceding paragraphs on groundwater impacts, irrigation with effluent at Dodge Flat and particularly rapid infiltration in Olinghouse Canyon, is likely to adversely affect the water supply wells at Wadsworth. It is possible that nitrate levels would increase to levels exceeding EPA primary drinking water standards after some years, probably within 10 years under rapid infiltration. The lack of nitrogen removal in the treatment process is likely to result in high nitrate levels in the groundwater.

Risk to Public Health

The probable increase in nitrate levels in wells in the Wadsworth area as discussed in the previous sections constitutes a threat to public health, particularly through an increased risk of methemoglobinemia in infants.

Other general aspects of risk to public health associated with wastewater disposal are discussed in the river disposal (Alternatives T-5, 6a, 12,14a and 15) and Truckee Canal disposal (Alternative L-1) impact sections. Land disposal by spray irrigation adds a new dimension to the risk issue. Aerosols of wastewater from the irrigation sprayers could elevate the level of risk for persons in close proximity to the spray. Considering the proposed irrigation operation, employees of the operation would constitute the main receptors for infectious agents.

Secondary treatment and chlorine disinfection would reduce the numbers of infective agents to typically acceptable levels for farm operations. The crops to be grown will not be directly consumed by humans, and there is a considerable history of similar irrigation operations without publicized illness problems.

However, in the sense of risk, the inhalation of infective agents reduces substantially the amount needed to initiate infection, and aerosol-borne pathogens provide the opportunity for inhalation. During sprinkler irrigation of wastewater, approximately 0.1 percent of the liquid is aerosolized (EPA, 1977). Aerosol droplets range in size from 0.01-50 microns in diameter and are suspended in air. When an airborne droplet is created, the water evaporates very rapidly under average atmospheric conditions, leaving an airborne nucleus of dissolved solids plus the microorganisms contained in the droplet. During this evaporation process, especially in sunlight, many of the microorganisms die, but some persist. There is a paucity of information concerning the actual risks associated with aerosols. The degree of hazard depends on several factors including treatment, climatic conditions and spray system design.

In general, pathogens in aerosols remain viable and travel farther with increased wind velocity, increase relative humidity, lower temperature and darkness. One study determined that fine mist could be carried 300-400 meters with an 11 mph (18 km per hour) wind and 1,000 or more meters with stronger winds (Sepp, 1971). A study of several agricultural settlements in Israel that use undisinfected wastewater for crop irrigation indicated that incidences of infection were substantially higher than in populations in similar agricultural situations that did not irrigate with wastewater (Katzenelson, et al., 1976). Although many harmless wastewater irrigators are in use, the Israel experience suggests that a public health risk is always present.

Cultural Resources

Based on the preliminary pipeline route, construction, maintenance, and increased human activity could disturb the same cultural resource sites discussed above for the pipeline to the Truckee Canal. The proposed reservoir site was not directly surveyed although this area was included in the general survey area. One prehistoric site, which has National Register potential (26Wa2678), would be directly affected by the irrigation of Dodge Flat. Two additional sites (26Wa2681 and 26Wa2682), one of which has National Register potential, appear to be located on the edge of the irrigated area. These sites could be disturbed through increased human disturbance if not directly by irrigation activities.

No cultural resources investigations have yet been initiated for the Olinghouse Canyon rapid infiltration area or for the Fernley drain pipeline route.

Land Use

Land use conflicts or changes will occur through construction of a 26.4-mile buried conveyance pipeline, a storage reservoir at Dodge Flat and cultivation of Dodge Flat under this alternative.

Pipeline-related land use impacts between Vista and Derby Dam will be the same as those discussed for Alternative L-1. Downstream of Derby Dam, the proposed alignment parallels the Truckee Canal and will be buried in the canal access road. Once buried, the pipeline will not interfere with use of the road. At this point there will be an additional railroad and a highway crossing. The remainder of the alignment to the proposed reservoir site crosses land used for livestock grazing and should not conflict with this use.

The proposed storage reservoir for Alternative L-6 would be located northwest of Wadsworth on reservation land and will cover about 67 acres (Cooper, pers. comm.). This land is currently used for livestock grazing and construction of this reservoir will remove the land from this use. The construction of a rapid infiltration area in an alluvial area of Olinghouse Canyon will also preclude its use for livestock grazing.

Dodge Flat, located on the Pyramid Lake Indian Reservation, is presently used for grazing. The area is not zoned for a particular use although the tribe is actively considering cultivating Dodge Flat. The tribal council has recently approved an irrigation study to be conducted for this area (Strong, pers. comm.). If all adverse impacts can be avoided or sufficiently mitigated, it appears that applications of effluent for crop production would be consistent with current plans for the area (Strong, pers. comm.). Construction of an irrigation system at Dodge Flat will permanently remove 4,130 acres of native vegetation and thus eliminate 4,130 acres of habitat for wildlife utilizing the area. Wildlife habitat will be replaced by crops which benefit the production of food and fiber and provide economic production.

An area outside Wadsworth including a portion of Dodge Flat has, however, been proposed as an alternative relocation site for the Cannon International Airport by the Airport Authority of Washoe County. Based on preliminary reviews by the Airport Authority, the Wadsworth site appears to be one of two preferred relocation sites. Any relocation effort would take about 20 years (Nevada State Journal, December 12, 1979). It is uncertain at this time how each project will affect the other if both the Dodge Flat effluent disposal and Wadsworth airport relocation projects are chosen. Planning efforts between each project should be closely coordinated to avoid or minimize any potential future conflicts.

Land use impacts associated with Alternative L-7 will be the same as those described for Alternative L-6. No proposal has been discussed for the method of disposal and conveyance that will be necessary for discharge to the Fernley drain. Depending on the method proposed, there may be some conflicts associated with this. The effluent would be used to enhance wildlife at the Fernley WMA and is considered a beneficial use.

Soils and Productivity. Generally, soils receiving wastewater would be impacted by increased organic matter, pH movement toward neutral, and increased nutrient levels. Soils in the Dodge Flat area have been mapped by the Soil Conservation Service, and a detailed chemical and physical analysis was made by Cooper & Associates (1980b).

Typically desert soils are alkaline and of marginal quality unless irrigated and fertilized. Irrigation, properly controlled, also serves to flush salts out of the root zone. This occurs regardless of the source of irrigation water. The addition of nitrogen and phosphorus found in the wastewater will enrich the soil. Potassium levels in wastewater are low, but this is not a problem on desert soils since background potassium levels are high. The additions of organic matter in the wastewater, although only a small quantity, will help to improve the soil by better tilth and improved moisture holding capacity.

Present productivity of these soils is limited to hardy native grasses and shrubs due to lack of water. Addition of effluent would therefore improve productivity substantially. After the first 3-5 years the productivity will remain relatively constant unless there is a dramatic change in wastewater characteristics.

Institutional Concerns

Land disposal at Dodge Flat will raise significant institutional issues regarding water availability and water rights. The Indian tribe currently has over 30,000 AFY of water rights, which would theoretically allow diversion of nearly all of the effluent in the early years of the Master Project. The Cities of Reno and Sparks, the tribe, or another group may need to acquire additional rights to enable discharge of 42,000 AFY to the land. However, the lack of return flow from this disposal and the effects of the reduced flow on Pyramid Lake and its fishery are likely to precipitate action by one or more of the many competing users of Truckee River water to reapportion the remaining available supply. Substantive institutional and legal questions will result, and court action is likely.

A related question concerns the ownership of the plant effluent. It is not clear whether the cities that treat the wastewater acquire title to it or if the title vests with the water right holders on the river. The resolution of this issue would affect the ease of transfer of the water to Dodge Flat, and might imply that the tribal water right could be exercised in addition to the 42,000 AFY disposal at Dodge Flat.

Public attitudes are also an element of institutional concern. Providing that it can be shown that the adverse impacts of land disposal of Dodge Flat can be avoided or greatly minimized, the Pyramid Lake Paiute Indian Tribe has not raised objections to the irrigation of Dodge Flat and is in favor of feasibility studies being conducted on the site. The tribal council has not formally approved these alternatives, however, and their approval would need to be secured before this project could proceed.

The primary objection to Alternatives L-6 and L-7, however, is the removal of 42,000 AFY from the Truckee River. Unless sufficient water can be obtained to satisfy all water rights downstream of Vista (including TCID) these alternatives will certainly be opposed by water users downstream of Vista. Some were concerned that salts could be leached from the soil and return to the Truckee River from the irrigation of Dodge Flat. Some Fernley residents were also concerned that effluent discharged to the Fernley drain under Alternative L-7 could contaminate adjacent domestic wells.

Energy

The Facilities Plan (Kennedy/Jenks, 1980) contains insufficient data to quantify energy use of the Dodge Flat disposal alternatives. This alternative employs a less energy-intensive treatment process than AWT with river discharge. However, it does require large pumps for effluent distribution and irrigation at Dodge Flat.

Aesthetics

The Dodge Flat land disposal alternatives are the only alternatives that imply any noticeable long-term aesthetic changes outside of the treatment plant site. The conversion of 4,200 acres of grazing land to green irrigated cropland would cause a substantial change in the appearance of this area of the Truckee River benchlands. The change may be seen as beneficial by some and adverse by others. The lands will be consistent in appearance with other agricultural lands, except for fencing and signing, which will detract from the open agricultural vistas.

The storage reservoir for irrigation and infiltration will create a new open body of water in an arid region. This change may be considered beneficial by some and adverse by others.

Mitigation of Dodge Flat Land Disposal Impacts

- Reduction of mean annual flows by 8-9 percent below Steamboat Creek

This impact can be fully mitigated by leaving the effluent in the Truckee River. It could also be partly mitigated by reduction in consumptive losses in the Truckee River basin.

Reduction of consumptive losses could occur through more efficient diversion, conveyance, and application of irrigation water, particularly where quality problems preclude reuse of percolated agricultural water. Reduction of consumptive losses can also occur through urban conservation, storage of water in reservoirs in the areas of lowest evaporation potential, minimizing the surface area of stored water, and reduction of diversions. Many institutional obstacles would have to be overcome prior to implementating any of these mitigations.

This impact could also be mitigated by reduction of water exports from the basin or importing water from another basin. These actions would have other consequences that could be at least as serious as the impacts of land disposal in the Truckee River basin.

- Reduction in low Q_{10} flows by up to 73 percent.

This impact can be mitigated by the methods described for the previous impact. It can also be partly mitigated by revising river management criteria to enable upstream storage of more water to augment low flow periods. The rules and regulations that govern Truckee River flow are complex.

Many institutions would be involved in any such change, and agreement would be difficult to reach.

- Substantial increases in risks to Newlands Project water shortages.

This impact can be mitigated by all of the methods described for the preceding two impacts. It could also be mitigated through the purchase of some Newlands Project lands and their withdrawal from irrigation.

- Increased concentration of background pollutants in Truckee River between Steamboat Creek and Pyramid Lake due to flow reduction.

This impact can be mitigated by providing flow augmentation during low flow periods to protect water quality. This requires a change in the river management rules, which is a difficult problem to resolve among the many affected institutions.

This impact can also be mitigated through reduction in background pollutant loading, particularly from various Truckee Meadows sources. The WCOG, through its 208 plan implementation, is pursuing various mitigations to reduce nonpoint source pollutants in the Truckee Meadows area. Progress toward improvements in water quality should be systematically monitored.

- Seepage of effluent applied for irrigation and percolated for disposal at Dodge Flat, polluting the lower Truckee River and Pyramid Lake.

The impact of these return flows can be reduced substantially, if not entirely, by eliminating the rapid percolation and discharging nonirrigation season plant effluent to an area where return flows to the Truckee River are not possible.

The impact could be further mitigated by monitoring percolated water, and pumping from the groundwater basin near the Truckee River to intercept percolating effluent before it can discharge to the river. These extraction wells would then need to discharge to the Dodge Flat irrigation project or to another location where pollution of the Truckee River would not occur. It is possible that the resulting quality would be adequate to allow irrigation elsewhere in the Truckee or Carson River basins.

The impact from rapid infiltration could also be mitigated by storing the nonirrigation season plant effluent that would otherwise be percolated. This stored plant effluent plus current plant effluent would then be applied to irrigate nearly twice the acreage during the irrigation season.

- Reduction in flows may lower Pyramid Lake and adversely affect cui-ui habitat. Lower flows may also inhibit cui-ui passage into the lower river.

This impact can be mitigated by eliminating the flow reductions predicted to occur. This can be accomplished by the methods outlined for the first two impacts listed in this mitigations section.

- Contamination of wells at Wadsworth by irrigation percolation and rapid infiltration of effluent at Dodge Flat.

This impact can be mitigated by not irrigating or percolating effluent near Wadsworth or by providing an alternative water supply. Well water quality should be regularly monitored.

- Public health risk from aerosols at Dodge Flat.

The potential for human contact can be minimized through incorporating design features and operational controls into the project, e.g., windbreaks, buffer zones, low pressure spray nozzles, low profile sprinklers, application methods to fit the terrain, wind patterns and adjacent land use, and alarm systems to ensure treatment reliability before spraying. The irrigation area should be fenced to impede trespass and marked with prominent signs warning of the risk to public health.

Flood irrigation would eliminate the formation of aerosols, but would increase percolation to groundwater, and would create a greater likelihood that surface runoff from the irrigated land would reach the Truckee River.

- Potential loss of or damage to historic and prehistoric cultural features.

  Prior to project design a 100 percent field survey will be needed to precisely determine the number and extent of cultural resources and necessary mitigations. The number of sites already recorded by a 10 percent field survey in the project area is lower than would be expected in a region of known aboriginal occupation. Although agricultural, residential, and industrial development has already destroyed many sites, many extant sites may be revealed by intensive survey. Evidence of buried sites may also be revealed by a careful examination of road cuts, erosion channels, and other exposure areas. Previous archeological investigations in the Lahontan Basin and Reno areas reveal a long and complex pattern of prehistoric occupation of the area; however, many important questions remain unresolved. Existing archeological sites, therefore, must be preserved.

Many institutions would be involved in any such change, and agreement would be difficult to reach.

- Substantial increases in risks to Newlands Project water shortages.

This impact can be mitigated by all of the methods described for the preceding two impacts. It could also be mitigated through the purchase of some Newlands Project lands and their withdrawal from irrigation.

- Increased concentration of background pollutants in Truckee River between Steamboat Creek and Pyramid Lake due to flow reduction.

This impact can be mitigated by providing flow augmentation during low flow periods to protect water quality. This requires a change in the river management rules, which is a difficult problem to resolve among the many affected institutions.

This impact can also be mitigated through reduction in background pollutant loading, particularly from various Truckee Meadows sources. The WCOG, through its 208 plan implementation, is pursuing various mitigations to reduce nonpoint source pollutants in the Truckee Meadows area. Progress toward improvements in water quality should be systematically monitored.

- Seepage of effluent applied for irrigation and percolated for disposal at Dodge Flat, polluting the lower Truckee River and Pyramid Lake.

The impact of these return flows can be reduced substantially, if not entirely, by eliminating the rapid percolation and discharging nonirrigation season plant effluent to an area where return flows to the Truckee River are not possible.

The impact could be further mitigated by monitoring percolated water, and pumping from the groundwater basin near the Truckee River to intercept percolating effluent before it can discharge to the river. These extraction wells would then need to discharge to the Dodge Flat irrigation project or to another location where pollution of the Truckee River would not occur. It is possible that the resulting quality would be adequate to allow irrigation elsewhere in the Truckee or Carson River basins.

The impact from rapid infiltration could also be mitigated by storing the nonirrigation season plant effluent that would otherwise be percolated. This stored plant effluent plus current plant effluent would then be applied to irrigate nearly twice the acreage during the irrigation season.

All sites (both historic and prehistoric) located within and adjacent to the project area must be protected from adverse impact due to construction, vehicular traffic, unsystematic collection, or other project-related activities until these sites can be properly evaluated by qualified archeologists and historians.

- Land use impacts at Dodge Flat, including loss of wildlife habitat and grazing land.

The losses of such uses could be mitigated through the use of other land areas, although such areas would also have certain land use impacts. The loss of wildlife habitat could be mitigated by an offsetting increase in permanent available habitat through acquisition and management. Management of some of the Dodge Flat disposal site for wildlife mitigation is also possible.

- Odors may be associated with the irrigation at Dodge Flat.

Odor control facilities can prevent odor formation in the pipeline to Dodge Flat, and in the storage and distribution facilities associated with the irrigation and infiltration systems.

Impacts of Truckee Canal Disposal (Alternative L-1)

The facilities needed to implement Truckee Canal disposal include expansion of the 30 mgd ESP capacity to 40 mgd, gravity flow filtration, and a flow equalization basin. Dechlorination of the effluent would be discontinued. The treated effluent would be conveyed by gravity pipeline about 18 miles to the point of discharge into the Truckee Canal. Sludge would be piped to Spanish Springs Valley and disposed of by spreading on the land.

The Truckee Canal disposal alternative has certain beneficial and adverse effects. In many ways the benefits identified for the Dodge Flat land disposal option also apply to the Truckee Canal diversion alternative (L-1). Treated wastewater discharged directly to the canal could, to some degree, replace river water now diverted to the canal, releasing river water for other beneficial uses. Effluent discharged to the canal would be mixed into river water and used for crop irrigation. JWPCP effluent would not be discharged directly to the Truckee River bringing about habitat and water quality improvements similar to those provided by the Dodge Flat alternative. Moreover, TCID would be assured of receiving initially 31,500 acre-feet per year of water which would rise to 42,000 acre-feet per year in the next 20 years.

This alternative was recommended for implementation in the Facilities Plan as the most cost-effective option.

The benefits of this alternative should be evaluated in comparison to the disadvantages.

The disadvantages, or adverse impacts of Truckee Canal disposal include Truckee River flow reduction, increased pollutant loads to the Truckee Canal, effects on beneficial uses of canal water, fisheries, groundwater, water supply, public health, aesthetics, institutional arrangements and air quality. These effects are discussed in turn in this section, with the major emphasis on water quality.

Surface Hydrology

The effects of Truckee Canal disposal on surface hydrology in comparison to the base case of Truckee River disposal are primarily as follows:

- Reduces mean annual flow from Vista to Derby Dam by 8 percent; no change in Pyramid Lake inflows.
- Reduces low Q_{10} flow by up to 28 percent at Vista and Derby Dam and by up to 16 percent at Pyramid Lake inlet.

- Increases spills from Lahontan Reservoir by about 20 percent.

- Affects the risk of M&I deficits very little, and reduces the risk of Newlands Project deficits.

The reduced flow below the JWPCP outfall will have some adverse effects on water temperature, fish habitat, and recreation, although insufficient data exist to quantify these effects. With reduced flow, velocity and depth will be reduced, and heat gain from solar insolation can increase temperature.

By increasing the assured amount of diversions from the Truckee River and by delivering this amount (the effluent) on a constant year-round basis, the Truckee Canal disposal option will result in increased spills from Lahontan Reservoir. This spillage is conveyed to downstream reservoirs and to the Stillwater Wildlife Refuge. The spillage will support beneficial uses in these areas, but it is lost to the Truckee River basin and is largely unavailable to the Newlands Project, except as it may be stored or directly used below Lahontan Dam.

The alternative has little effect on the occurrence and relative severity of M&I water supply deficits in the Truckee Meadows. The risk of agricultural water supply deficits would be decreased due to the assured supply of water discharged to the Truckee Canal.

The secondary effects of growth supported by expansion of the plant from 30-40 mgd would potentially reduce flows between 0-5 percent at Vista, a common impact of each alternative as previously discussed.

The implementation of Truckee Canal disposal would require changes in the diversion schedules at Derby Dam. Revision to the diversion criteria to recognize the recommended alternative of effluent discharge directly to the Truckee Canal is a relatively simple mathematical exercise, but is difficult institutionally. The total allowable diversion to the Newlands Project is currently disputed, with TCID following criteria for 406,000 acre-feet per year and the WPRS promulgating criteria for 288,000 acre-feet per year. If the criteria are modified, it may complicate this dispute, or even influence its outcome. At a minimum, an agreement between the Cities of Reno and Sparks and TCID would be required. At worst, the implementation of this alternative could become bogged down in an institutional and legal morass.

The hydrologic modeling in this EIS assumes that the JWPCP effluent would comprise a portion of TCID's allotment, replacing a like amount of surface water. It might also be possible for TCID to obtain the JWPCP effluent in a direct contract with the Cities of Reno and Sparks as a supplement to Newlands Project water. If TCID is eventually restricted to 288,000 acre-feet per year from the Truckee and Carson Rivers basins, this latter approach might be very desirable for TCID, assuming quality objections can be resolved.

Such an approach would increase the diversions from the Truckee River basin slightly above those used in the model analysis. This would slightly increase the calculated flow reduction between Vista and Derby Dam, and would cause a slight decrease in flows to Pyramid Lake. The extent of these additional reductions has not been quantified, since this approach to transferring the effluent seems institutionally less likely in view of past litigation.

An additional flow-related impact is the potential desire of Truckee River management entities to seek flow augmentation between the JWPCP site and Derby Dam. If it is determined that these flow reductions should be mitigated at certain times, some new management criteria will be required to regulate the river differently. As discussed in the section on impacts of land disposal, flow management changes are complex, and require careful evaluation to quantify effects.

Water Quality

The Truckee Canal disposal option (Alternative L-1) removes the effluent from the Truckee River system upstream of Derby Dam, discharging secondary treated effluent to the canal and probably allowing seepage and spills back to the Truckee River. This alternative will have adverse effects on water quality in the lower Truckee River, Truckee Canal, Lahontan Reservoir, the lower Carson River, and on beneficial uses of this water as described in this section.

The effects are summarized as follows:

- Elimination of toxicity from Truckee River and Truckee Canal due to chlorine.
- Elimination of toxicity due to ammonia, nitrite and nitrate in the Truckee River between the outfall and Derby Dam.
- Slight reduction in Truckee River flow between the outfall and Derby Dam during low flow periods causing increased concentration of background pollutants due to loss of some diluting flow.

- Continue ammonia and nitrite toxicity in the Truckee Canal.
- Pollutants, including high levels of nitrogen, will continue to be discharged to the lower Truckee River due to spills and seepage from the Truckee Canal.
- Algal growth potential and most pollutants, except nitrogen, in Truckee River below Derby Dam would be reduced in volume below ESP levels, even considering spills and seepage back to the Truckee River.
- Inflows to Pyramid Lake would be unchanged.
- Reduction in JWPCP threats to cui-ui and Lahontan cutthroat trout from nutrients, heavy metals and refractive organics.
- Pollutant loads in the Truckee Canal will be higher than historic levels, threatening beneficial uses.
- High nitrogen loads, along with other pollutants, will be conveyed to Lahontan Reservoir.
- During most months, Truckee River diversions will dilute effluent in the Truckee Canal, but during some winter months the canal flow will be 100 percent effluent.
- The community of Hazen will have severe public health threats from the use of untreated Truckee Canal flows, which can be 100 percent JWPCP effluent, for its potable water supply.
- Algal growth in the Truckee Canal will probably change little, even though growth potential will increase.
- Algal growth in feeder canals, local irrigation ponds and other facilities will increase due to high nutrient levels.
- A significant risk of impairment to Lahontan Reservoir beneficial uses may exist due to pollutants, particularly high nitrogen loads.
- Ammonia and nitrite could reach Lahontan Reservoir, possibly causing toxic conditions and fish kills.
- Pollutants released to the lower Carson River may adversely affect wells that provide Fallon's water supply.

Truckee River

Water quality effects on the Truckee River upstream of Derby Dam would be identical to those described for Dodge Flat land disposal. The effluent would be removed from the Truckee River above that point. Growth in the Truckee Meadows would have potential secondary effects on water quality through urban runoff. Flow reductions between the JWPCP outfall and Derby Dam will cause an increase in pollutant concentrations, particularly during low flow periods. This reduces the ability of the Truckee River to dilute the background pollutant load, particularly nonpoint source pollution from the Truckee Meadows. These quality changes will be similar to those discussed for land disposal, but on a less severe scale, since flow reductions would be less.

Under the Truckee Canal disposal alternative, the secondary treated wastewater would be discharged to the head of the Truckee Canal. Normal canal operations involve spillage of some water back to the Truckee River in the reach where the canal and river are parallel. Water seeping from the unlined canal flows back to the river. These returns are estimated to comprise about 20 percent of the water diverted into the canal. Under this alternative, the effluent would have phosphorus removal and filtration, but would not be treated to convert ammonia to nitrates or reduce total nitrogen concentrations from about 21.5 mg/l to 5 mg/l as would occur with AWT and river discharge. Thus, a high nitrogen load will be spilled to the lower Truckee River, with the concentrations in the spills and seepage depending on the mix of effluent and diverted Truckee Canal water.

This dilution of effluent with Truckee River water diverted into the canal can vary from 0 (100 percent effluent) to about 14 to 1 dilution. During many winters the effluent would comprise 100 percent of the flow for several months. During the spring runoff season high diversions into the canal would provide maximum dilution. Average monthly dilution rates computed from hydrologic model output range from 0.1:1 up to 5.0:1 under 288 criteria, and 1.4:1 up to 4.5:1 under the 406 criteria, depending on the month.

The pollutant load accreted to the river from the canal was estimated by assuming that the accretion moves through the soil without soil uptake or losses of any type. This assumption, although very conservative in relation to the seepage portion of these losses, does allow for comparisons between disposal options.

Tables 5-4 and 5-5 show the total nitrogen and phosphate loadings for existing conditions, ESP, and the three JWPCP alternatives. These tables illustrate that the Truckee Canal discharge alternative would result in the largest total nitrogen loading to the lower river of any of the alternatives, assuming no uptake of nitrogen.

The total nitrogen load in the lower river after these accretions is 7-8 percent higher than for river disposal under the 288 and 406 criteria. Since passage through the soil does remove some nutrients from the seepage portion of the accretions to the river, the actual difference between the nitrogen loading of Truckee Canal disposal as compared to AWT with Truckee River disposal may be negligible.

Due to the spills and seepage from the Truckee Canal to the lower Truckee River below Derby Dam, water quality conditions in the river are expected to be similar to somewhat better than those under Truckee River disposal, but not as good as with land disposal at Dodge Flat.

Tables 5-11 and 5-13 show the estimated total nitrogen and total phosphorus loads just below Derby Dam and also downstream from the entry of the spills and seepage. From these loads (which use the conservative assumption of no uptake or loss in the accretions) it can be seen that the AGP will be reduced below the ESP levels and that most constituents would be reduced relative to river disposal of the JWPCP effluent.

Pyramid Lake. The general nature and magnitude of wastewater constituents, especially nutrients, reaching Pyramid Lake was discussed in Chapter 4 and in the section of this chapter on the impacts of river disposal to Pyramid Lake. A main purpose of Truckee Canal disposal (Alternative L-1) is to remove JWPCP effluent from Pyramid Lake without altering river discharge to the lake. Assuming that TCID operations can be managed to accommodate a trade-off of undiluted JWPCP effluent for Truckee River water, the objective of not altering instream flows below Derby Dam and into the lake appears achievable.

Removal of the effluent from the Truckee River and thus Pyramid Lake without altering instream flow has obvious benefits for Pyramid Lake. Without a direct discharge to the river, the risks of polluting the lake or impairing its beneficial uses are greatly diminished. Potential pollutants such as nutrients, toxic heavy metals and refractive organics that originate in the Reno-Sparks sewage system theoretically should not be transported to the lake. Any jeopardization of the endangered cui-ui and threatened Lahontan cutthroat trout from JWPCP effluent could be abated. Socially and aesthetically the concerns about the long-term welfare of the lake relative to excessive eutrophication would probably be allayed.

However, the way Alternative L-1 is proposed for construction fails to fully achieve all of the potential benefits for Pyramid Lake, because wastewater discharged to the canal near the headworks can be turned directly back into the river below Derby Dam and can also percolate through the soil to the river. These returns to the river are estimated to annually constitute about 20 percent of the water diverted into the canal. Data indicating the amount of pollutants that return are not available; consequently, it was estimated that wastewater constituents entering the lower river and the lake would be proportional to flow.

It is important to note that the JWPCP discharge to the canal would not be treated to convert ammonia to nitrates or to reduce the total nitrogen concentration from about 21.4 mg/l to 5 mg/l. The secondary treated effluent would be filtered, chlorinated and perhaps dechlorinated and have phosphorus removal. As a result significant amounts of total nitrogen would continue to augment the total nitrogen load entering Pyramid Lake. In a similar manner other potential pollutants of municipal wastewater origin would flow to the lake.

Assuming that historical river operations are continued, the total nitrogen load to Pyramid Lake would be decreased by about 2,137 pounds per day or 38 percent compared to the 30 mgd ESP (Table 5-4). The reduction in the total nitrogen load between present conditions and 40 mgd Truckee Canal disposal is estimated to be 8 percent. In the absence of total nitrogen returns from the canal to the river, the reduction in total nitrogen to the lake at the time of conversion from 30 mgd ESP to Master Project could be 3,538 pounds per day or 63 percent.

Achievement of the potential benefits to the lake associated with Alternative L-1 would require moving the point of discharge about 10 miles downstream in the canal to prohibit direct returns of effluent to the river and to minimize any seepage returns to the river.

Truckee Canal. Under the Truckee Canal disposal alternative, all of the effluent is discharged to the canal, plus direct diversions from the Truckee River as needed to meet irrigation needs. The projected quality of the effluent is shown in Table 5-22. The high pollutant loads in the effluent have the potential of adversely impacting the canal, the lower Truckee River, the Truckee Bench, and Lahontan Reservoir.

The pollutant load remaining in the canal after seepage and spillage losses will vary by constituent. The total nitrogen load remaining in the canal under canal disposal will average four and nine times the load remaining in the canal under Truckee River disposal on an annual basis for 288 and 406 criteria, respectively. The phosphorus loading will be less than under present conditions and greater than with the ESP. Table 5-23 illustrates the average monthly concentrations for various constituents in the Truckee Canal, along with average dilution rates. It should be noted that a zero dilution condition will commonly occur in many winters,

Table 5-22. Characteristics of the JWPCP Effluent Under Truckee Canal Disposal

	Concentration (mg/l)	Load (lbs/day)
NO_3-N	1.0	323
NO_2-N	1.5	485
NH_4-N	16.0	5,174
Org. N	3.0	970
Total N	21.5	6,953
Total P	.40	129
PO_4-P	.37	121
TDS	350	57[1]
Chloride	34	10,996

[1] tons/day.

DATA SOURCE: From Kennedy/Jenks, 1980.

Table 5-23. Comparison of Calculated Average Monthly Dilutions and Resultant Quality at the Head of the Truckee Canal (quality in mg/l, 40 mgd of effluent)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum Historical	Minimum Historical
288 Criteria, Truckee Canal Disposal														
Dilution Ratio														
River water: effluent	0.63	0.84	1.21	4.99	4.35	1.68	1.79	0.38	0.05	0.08	0.26	0.30	12.9	0.0
Concentration														
Total Nitrogen	13.6	12.2	10.1	4.0	4.3	8.3	8.5	16.1	20.5	20.0	17.4	16.8	21.5	1.8
Total Phosphorus	0.26	0.24	0.20	0.08	0.09	0.16	0.18	0.31	0.38	0.38	0.33	0.32	0.40	0.04
TDS	247	229	188	87	87	152	186	292	339	334	303	292	350	42
Chloride	23.4	21.7	17.8	8.0	8.1	14.4	17.1	27.8	32.8	32.3	29.0	28.1	34.0	3.9
406 Criteria, Truckee Canal Disposal														
Dilution Ratio														
River water: effluent	1.43	1.35	1.95	2.73	1.73	2.57	2.61	4.37	4.50	5.23	3.79	1.40	12.9	0.0
Concentration														
Total Nitrogen	9.5	9.8	7.8	6.2	8.1	6.3	6.9	5.3	5.0	4.6	5.7	9.7	21.5	2.1
Total Phosphorus	0.19	0.20	0.16	0.12	0.16	0.13	0.15	0.13	0.12	0.11	0.14	0.20	0.40	0.06
TDS	193	199	159	124	145	122	169	161	145	143	166	206	350	68
Chloride	17.9	18.5	14.8	11.5	13.8	11.5	15.3	14.1	12.8	12.5	14.6	19.0	34.0	6.0

[1] Concentrations in mg/l, Total Nitrogen as N, Total Phosphorus as P, Dilution ratios are dimensionless.

DATA SOURCE: PEL, 1979; Jones & Stokes Associates, Inc., and DRI, 1980; Kennedy/Jenks, 1980.

since historically there have been many such periods with no diversion into the canal. During the months when the irrigation demands are high and there is a high diversion into the canal, the dilution is at its maximum, about 14:1. The canal flow will range between 100 percent effluent and 14:1 dilution with river water depending on river operating criteria, irrigation demand, and hydrologic factors.

The effect of nutrients on the AGP of the Truckee Canal will be adverse and lead to increased algal growth. Preliminary results from AGP tests conducted by the USGS showed there was a slight reduction in the AGP between Fernley and the terminus of the canal under existing conditions. These data indicate that other factors may limit the growth of algae and uptake of nutrients. These factors most likely relate to physical canal properties and are unlikely to change with implementation of the JWPCP.

Therefore, algal growth is expected to be similar to existing levels, being constrained by other factors. It appears that nutrients are currently in excess of algal needs. With canal disposal the excess will still exist, and the potential will be carried to lateral canals, holding reservoirs, other irrigation facilities, Lahontan Reservoir and the lower Carson River, where conditions may be more amenable to algal growth.

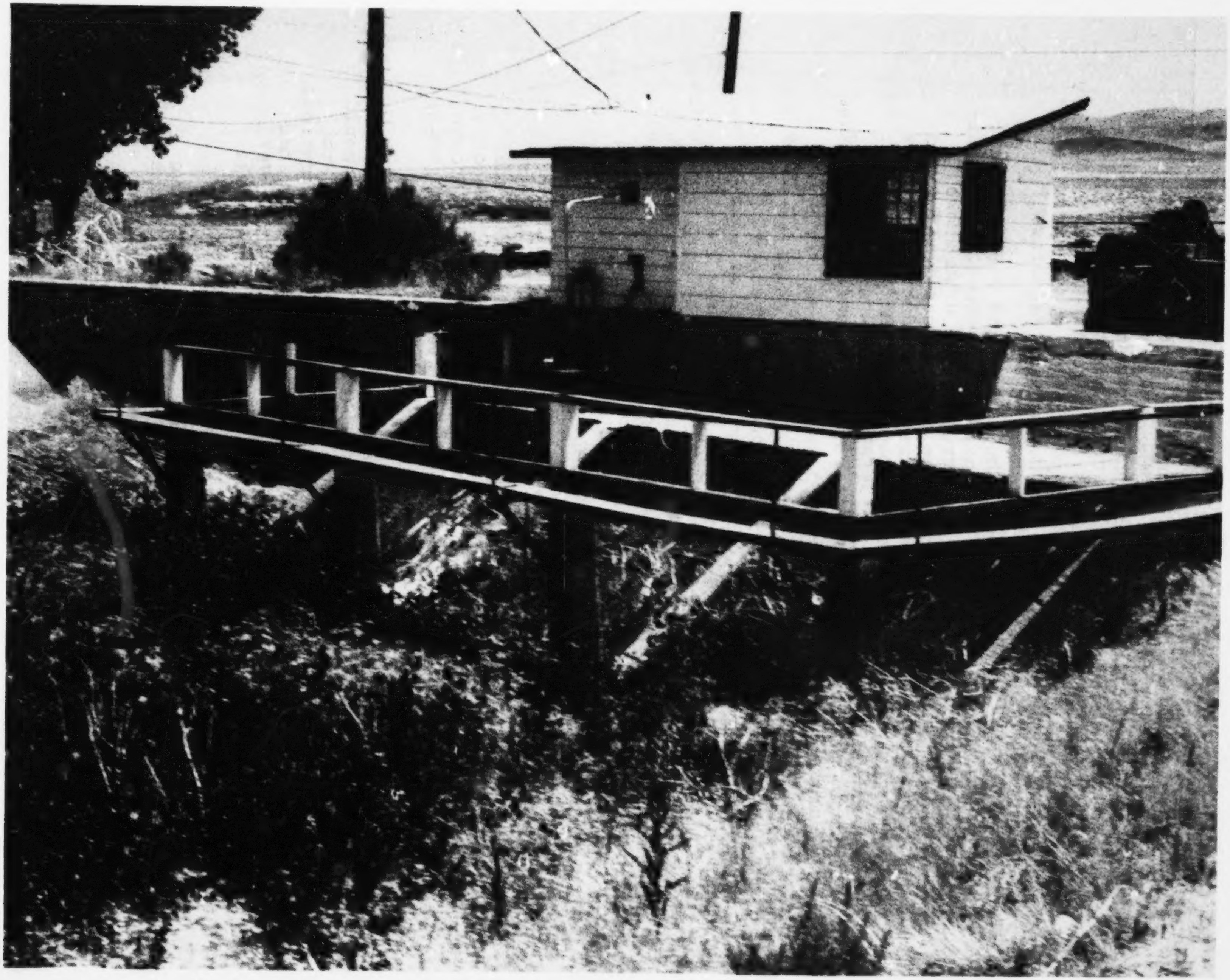
The decrease in phosphorus levels as a result of JWPCP treatment may lead to a phosphorus-limiting situation in these locations, with an excess of nitrogen remaining.

The increase in TDS and chloride in the Truckee Canal will adversely affect irrigated crops and agricultural soils. Additional irrigation may be required to flush salts through the root zone, thereby decreasing irrigation efficiency and increasing water requirements.

At the head of the Truckee Canal, most nitrogen would be in the form of ammonia, because little nitrification would take place in the enclosed pipe from the JWPCP plant to the head of the canal. Estimated unionized ammonia concentrations at the point of discharge to the canal, under average water year conditions, are shown in Table 5-24. The EPA- (1976) recommended criterion of 0.02 mg/l for aquatic life would be frequently violated.

The higher wasteload in the Truckee Canal will also adversely affect wells that draw on groundwater near the canal, as discussed in the water supply and groundwater sections.

Lahontan Reservoir. The effects of this alternative on the Truckee Canal were identified and discussed in a previous section. Water flow, as well as potential pollutant loading, is greatly altered in comparison to the river disposal and



Truckee Canal Forebay for Lahontan Dam Powerhouse.

Table 5-24. Computed Unionized Ammonia Concentrations at the Point of Discharge to the Truckee Canal under the Canal Disposal Alternative[1]
(40 mgd)
(mg/l)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
288 Criteria, Canal Disposal												
NH_3-N	0.28	0.15	0.13	0.08	0.07	0.05	0.01	0.02	0.11	0.30	0.24	0.29
406 Criteria, Canal Disposal												
NH_3-N	0.07	0.02	0.05	0.05	0.05	0.03	0.02	0.04	0.10	0.10	0.08	0.07

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[1] Assumes

	River Temperature	River pH	JWPCP Temperature	JWPCP pH
June-October	15.1°C	8.0	27°C	7.5
November-May	4.9°C	7.5	22°C	7.5

DATA SOURCE:
Jones & Stokes Associates, Inc. and DRI, 1980; DRI, unpublished data; Kennedy/Jenks, 1980; PEL, 1979.

land disposal options. Canal hydrology during the irrigation season would not be appreciably altered, but during the non-irrigation season, April to November, the canal would often convey undiluted treated wastewater into Lahontan Reservoir. Treatment would include secondary biological treatment, phosphorus reduction, chlorination and dechlorination, and sand filtration. Nitrogen reduction is not included in the treatment. Initially the canal would receive about 30 mgd or 46 cfs of effluent which would incrase to 40 mgd or 62 cfs in about 20 years. During most months of the year, particularly the irrigation season, effluent would be diluted with Truckee River water and large portions diverted from the canal before reaching the reservoir. However, during several months in many years, an average of 46-62 cfs of effluent would flow undiluted into the reservoir. Table 5-19 illustrates the average daily loads of selected wastewater constituents that could enter the reservoir both annually and during the nonirrigation months.

Kennedy/Jenks (Draft Facilities Plan, 1980) evaluated the water quality of Lahontan Reservoir with the Truckee Canal disposal option (Alternative L-1) superimposed upon reservoir quality. Their analysis concluded that the Truckee Canal disposal option would exert no significant influence upon Lahontan Reservoir during the irrigation season and only a localized influence during the winter. On the other hand, available data can be interpreted to indicate that a significant risk exists to cause an impairment of existing uses.

The average annual total nitrogen load to Lahontan Reservoir will increase from the existing 1,947 pounds per day through an ESP load of 2,183 pounds per day to a range of 3,890-5,037 pounds per day at 40 mgd, depending on whether the 288 or 406 criteria are assumed. Under these two scenario conditions the estimated background load without a JWPCP discharge would be 158-664 pounds per day. Alternative L-1 does not include nitrification or denitrification treatment processes, accounting for the large increase in total nitrogen load over other alternatives.

Phosphorus removal is a feature of the 40 mgd Master Project, however, and total phosphorus loading is projected to be from 76-109 pounds per day (see Table 5-5 for comparison to other alternatives). The comparable 1978 load would be 468 pounds per day, and the 30 mgd ESP load would range from 19-60 pounds per day to the reservoir, depending on whether 288 or 406 criteria are assumed.

It is recognized that nutrients and other potential pollutants discharged from the canal may not fully mix into the reservoir before being released from the reservoir either with irrigation or spill water. It has been assumed in the Kennedy/Jenks (1980) analysis that much of the effluent entering the reservoir would directly leave the reservoir before mixing could occur because of the close proximity of the canal discharge and the outlet of the reservoir. This situation is described in Chapter 4 - Lahontan Reservoir. After considering the absence of any field testing, it was concluded that the EIS analysis should assume that the total canal flow would mix into the reservoir before release from the reservoir.

Discharge to the Truckee Canal (Alternative L-1) is expected to significantly adversely affect the aquatic ecology and the beneficial uses of Lahontan Reservoir. The state of eutrophication of the reservoir, as discussed in Chapter 4, reveals a present condition of excessive nutrients with nitrogen being a limiting nutrient. Total annual nitrogen loading could increase over the present by 100-159 percent. The areal loading rate for total nitrogen may range from 12.63-16.36 grams/m^2/yr as compared to the present 6.32 grams/m^2/yr.

Alternative L-1 would decrease the Truckee Canal total phosphorus load from the present 1.80 grams/m^2/yr to 1.10 grams/m^2/yr under 406 operating criteria. If no-action is taken the total phosphorus load would decrease by 96-87 percent. Because of the relatively total phosphorus load from the Carson River (Table 5-19), it is questionable whether lowering the total phosphorus load from the Truckee Canal will have a long-term general effect on algal growth in the reservoir. It is assumed that the lower orthophosphate load will restrict an immediate use of the increase in soluble nitrogen in the vicinity of the point of discharge.

The areal loadings presented above consider a maximum loading from the Truckee Canal only. These loadings are much less than the Carson River COG estimates, due to the reduction in phosphates by JWPCP treatment. The Carson River COG (1978) reproted an areal loading in Lahontan Reservoir of 1.8-2.9 grams/m^2/yr. Even with improvement in the effluent phosphate concentration from the JWPCP, the total phosphate areal loading to Lahontan will still be large and dominated by the Carson River (Table 5-19). On-going pollution control activities in the Carson River basin will hopefully reduce this phosphorus input.

Without the use of a verified model to project nutrient load and algal production, it is difficult to judge the magnitude of change the greater input of nitrogen will have on the presently excessive algal blooms and diminished DO in the reservoir.

The decrease in the present 468 pounds per day total phosphorus is expected to offset to some extent the 100-159 percent increase in total nitrogen loading. The reservoir is expected to become phosphorus-limited for algal growth in the vicinity of the canal discharge. Whether the presently occurring algal blooms will diminish or not is only subject to speculation. An abundance of nitrogen and shortage of phosphorus may tend to inhibit nitrogen fixing blue-green algae, which are now a reported problem in the reservoir. It can also be assumed that a unique community of algae will establish to make maximum use of the nutrients present.

Recent work on eutrophication suggests that removal of phosphorus from external sources is the key to control of eutrophication. A classic example of this is Lake Washington. Following the diversion of treated sewage away from the lake (which removed 55 percent of the total phosphorus and 12 percent of the total nitrogen) quality conditions greatly improved. The lake changed from its eutrophic status to mesotrophic. Considering the large loads of nutrients contributed by the Carson River, data are not available to judge the future of Lahontan Reservoir in comparison to other lakes.

AGP studies by Lider, et al. (1980) indicate that algal growth characteristics in the reservoir may also be influenced by heavy metals, organically bound nitrogen, or other nutrient combinations. They did show that total soluble inorganic nitrogen had less effect on algal growth at nitrogen to phosphorus ratios greater than 11:1. Certainly reductions in the total phosphorus loading may have some positive effect by causing the N to P ratio of 11:1 to be exceeded earlier in the algal bloom growth pattern.

In addition to effects on algae, the large increase in nitrogen loading may have other possible effects that depend on the form of the nitrogen, i.e., nitrite or ammonia. If large amounts of ammonia enter the reservoir there is the opportunity for fish kills to occur. The treatment plant would discharge an average ammonia concentration of 16.0 mg/l. The initial discharge to the canal of 30 mgd would represent an average daily load of 3,970 pounds per day which would increase to 5,350 pounds per day at 40 mgd. Some presently undetermined percent of the discharged ammonia could reach Lahontan Reservoir. The opportunity for ammonia and nitrite to reach the reservoir would be greatest in the cold season. The concentration of ammonia between the point of discharge and the reservoir would diminish due to nitrification, biological uptake, and gaseous loss to the atmosphere in addition to diversion. The fate of the ammonia at the reservoir is speculative and depends to a large extent on season and whether water entering the reservoir is directly released downstream. No data are available to adequately address this problem.

Acutely toxic conditions and fish kills can occur if the concentration of unionized ammonia exceeds about 0.2 mg/l NH_3-N. A worst case condition is likely to occur in the spring, a short time after turnover, when ammonia concentrations may be high, the temperature is increasing, and rapid algal growth quickly raises the pH.

Under some circumstances algae, especially blue-green algae, impart an unpleasant flavor to fish. Excessive eutrophication and chronic soluble inorganic nitrogen limitations appear to increase the chances for blooms of nitrogen fixing blue-green algae. Among the problems engendered by this condition is the impacting of unpleasant flavors and odors to the water and fish. The soiling of equipment and bathing gear can become significant enough to inhibit recreational uses. Furthermore, if the reservoir were to be used as a drinking water supply, expensive water treatment processes to remove taste and odor may be required.

The Truckee Canal option has the potential of impacting water quality conditions below Lahontan Reservoir. During the irrigation season when canal water can by-pass Lahontan Reservoir, or if it comprises a major portion of the reservoir release, the lower Carson River will receive most of the JWPCP load. This will increase total pollutant loading to the river and agricultural lands.

During the period when releases from Lahontan Reservoir are greatest the JWPCP pollutant load would receive its greatest dilutions. The total load and concentrations of individual constituents, however, will be increased over existing levels. The extent of these increases cannot be quantified based on existing tools and data for the reasons previously discussed.

Institutional Constraints

Implementation of this alternative would require significant changes in contracts between TCID and the WPRS and perhaps between TCID and other entities. An operational protocol and contract would have to be established between TCID and Reno and Sparks. A change in point of diversion requiring approval of the state engineer may be required as well as the establishment of state water quality standards specifically for the Truckee Canal. Other unidentified permits and agreements may be required to avoid conflict and litigation over potential effects on beneficial uses associated with Lahontan Reservoir. No information is available to indicate how institutional requirements may be consummated or resolved.

Fish and Wildlife

Fish. Fishes common to the Truckee River can also be found in the Truckee Canal and recreational fishing in the canal is reported (Sumner, pers. comm.). When water temperatures are sufficiently low, rainbow, brown, and Lahontan cutthroat trout could live in the canal, and the NDW wishes to retain a seasonal sport fishery in the canal. Information concerning fish population types, sizes, and distributions is lacking. Certainly, large seasonal variations in flow, canal morphology, water diversions, and water temperature adversely affect species use of the canal; consequently, it is assumed that the canal fishery may have limited potential and field investigation is required before its quantitative value can be ascertained. The Truckee Canal disposal alternative (L-1) can significantly and adversely alter the canal for fish habitation while improving the quality of fish habitat in the Truckee River from Steamboat Creek to Derby Dam.

During some nonirrigation months of low water years, the effluent will not be diluted by river water. The average dilution ratio by month can range from 0 to about 13 (Table 5-23). Typically the ratio of surface water to effluent is about 2 to 5:1 during the irrigation season and much less in the winter. Water diversions by either the 406 or 288 scenario criteria significantly affect the amount of effluent dilution.

Under the 406 criteria, which approximates present canal operations, the effluent would on the average receive about 1.5 times or more dilution. However, during some nonirrigation season months in low water years there may be 0 dilution; moreover, the schedule for diverting water from the Truckee River is quite different using the 288 criteria when winter time flow in the canal would almost cease. Dilution of the effluent from August through February may be less than 1:1 and often 0. There is no evidence that a wide variety of fish and fish food organisms can survive and be productive over several months in almost pure effluent of the proposed type.

The effluent is expected to be acutely toxic from ammonia and nitrite. Any failure in chlorination and dechlorination control would also inject chlorine toxicity into the canal. Toxic unionized ammonia concentrations that could occur with certain assumed conditions are reported in Table 5-24. The average condition of unionized ammonia would exceed the Truckee River water quality standard of 0.016 mg/l under almost all circumstances. At present there is no confirmed water quality standard for unionized ammonia for the Truckee Canal. Unionized ammonia is toxic to trout at concentrations of about 0.2-0.6 mg/l.

During low dilution periods the average concentration of NO_2-N of 1.5 mg/l in the effluent is expected to add to the level of acute toxicity in the canal. Acutely toxic concentrations of nitrite (96 hrs LC_{50} data) for trout typically range from about 0.2-0.4 mg/l, and it is assumed that concentrations of this magnitude will occur in the canal during times of low dilution.

It seems likely that occasional slugs of chlorine will be discharged to the canal, and if concentrations of chlorine in the canal exceed about 0.02 mg/l a fish kill may occur.

Other forms of toxicity that are not well defined are typically associated with sewage effluent. Only a few of the potential toxicants in sewage effluent are measured and evaluated, e.g., ammonia, nitrite, chlorine, zinc, cadmium, etc., while many insidiously toxic organic substances, especially halogenated hydrocarbons are not measured. A variety of substances soluble in water at even trace concentrations tend to be biologically accumulated by fish and fish food organisms. Polychlorinated biphenyls (PCB) and DDT are well publicized substances of this type. It is assumed that chronically toxic and harmful substances capable of being bioaccumulated pose a potential risk to fish and humans in relation to the dilution of the sewage effluent and length of time available for natural purification processes to render such substances harmless. Effluent flow vs. surface water dilution conditions in the canal are assumed to significantly increase the risk that fish, especially desirable sport fish, will be unable to productively reside in the canal even when habitat conditions are otherwise favorable. Also, the risk for contamination by organic substances harmful to the fish and possibly humans eating fish caught from the canal would be increased in proportion to the lack of dilution flows.

The existing operation of the Truckee Canal could cause effluent to be discharged to the lower Truckee River. Typically, the effluent would be diluted by one or more times in these events. However, the turnout of canal water containing effluent to the lower Truckee River poses some risk to fish in the lower river which is similar to that described above. The risk would be greatest in times of treatment plant failure or periods of low effluent dilution.

Endangered Cui-ui. The endangered cui-ui may be adversely impacted by two features of the Truckee Canal disposal alternative (L-1). During treatment plant failures, insufficiently treated toxic and oxygen-consuming wastewater could be released from the canal into the lower Truckee River. The magnitude of the effects of such an event would be contingent on the size and duration of the failure, dilution flows in the river, and season. A maximum effect could be expected during low flow conditions in the spring and early summer spawning and larval fish dispersion activities.

During normal JWPCP and Truckee Canal operations, effluent in varying concentration, depending on dilution flows, would seep through the soil into the lower river. In the irrigation season canal water containing effluent would be diverted directly to the lower river. These conditions were discussed in Chapter 4 and previous sections of this chapter. These return flows to the lower river are a potential risk to the well-being of the fishes in the lower river. It is assumed that the risk is somewhat lower than that described previously for fishes in the canal, because these events will have their greatest occurrence during higher canal flows and thus times of maximum dilution of the effluent.

During some months and flow schedules this alternative (L-1) has the potential to significantly alter instream flow below Derby Dam (Figures 5-5 and 5-6) for example, using the 406 criteria scenario, instream flows during March may be reduced during peak flow years and increased during subnormal water years. In the case of the 288 scenario both high and low flow conditions are reduced while median flows are increased in March. However, in the data presented (Figures 5-5 and 5-6) the canal disposal option seems to slightly improve low flow conditions. It is assumed that future conditions may lie somewhere between the 406 and 288 scenario cases and that any alteration in flow attributable to the JWPCP can be remedied through river operations not inconsistent with present practices.

Threatened Lahontan Cutthroat Trout. Water quality in the native Truckee River habitat of this species will be improved, and insofar as conditions relatable to the JWPCP are concerned, not limit the productivity of trout. Instream flow between Vista and Derby Dam would be decreased as illustrated by the flow duration analyses in Figures 5-5 and 5-6. According to the 288 scenario analysis for March, significant flow reductions may occur in the spring spawning season. Generally, flow reductions in this reach would reduce the amount and quality of trout habitat. Data are not available to interpret the magnitude of these reductions, but this reach is currently being studied by the USGS and the USFWS in a manner that will augment present knowledge.

Wildlife. This alternative contains no identified adverse impacts on wildlife

Groundwater

The Truckee Canal discharge alternative (L-1) will adversely affect groundwater along the Truckee Canal and in areas where wastewater will be used for irrigation. Figure 5-7 shows the sections where wells are located. At present a mixture of plant effluent and Truckee River water, nearly always diluted 1:1 or more, is diverted into the Truckee Canal for irrigation use and storage in Lahontan Reservoir. With the Truckee Canal disposal option, effluent will comprise 100 percent of the flow in the canal for some months of many years.

Over time, ranging from a year or less to many years, depending on location, the change in percolated water quality is likely to cause an increase in nitrate, TDS, and trace elements present in the groundwater. These quality changes will eventually reduce the desirability of the water supply for potable use and could cause certain constituents to exceed EPA limits for potable use, depending on crop uptake, irrigation efficiency, groundwater flow rates, dilution, and other factors.

There is also potential for increases in nitrate and TDS in groundwater in the Fallon area. This would occur only to the extent that Truckee Canal water is routed into the Carson River system. Impacts in the Fallon area would be of lesser magnitude than in the Fernley area because of effluent dilution by Carson River water. During normal water years under fairly recent (1973-1975) operating conditions, the annual inflow of the Truckee Canal to Lahontan Reservoir has amounted to about 25-35 percent of the annual outflow of the reservoir into the Carson River (Table 5-25). During drought years, such as 1976 and 1977, inflow to the reservoir from the canal exceeds outflow.

The most immediate changes would occur in the shallow sedimentary aquifers. Over time, changes in the quality of the deeper basalt aquifers would occur. These deeper aquifers serve as municipal supplies to the City of Fallon and the Fallon Naval Air Station. TDS and nitrate standards would probably not be violated, however, in view of the general levels of dilution of the Truckee Canal water by Carson River water.

Public Health

The discharge of secondary treated, filtered, and disinfected wastewater to the Truckee Canal poses a significant public health risk to the Town of Hazen which withdraws water

FIGURE 5-7

GENERAL LOCATIONS OF WELLS ALONG TRUCKEE CANAL

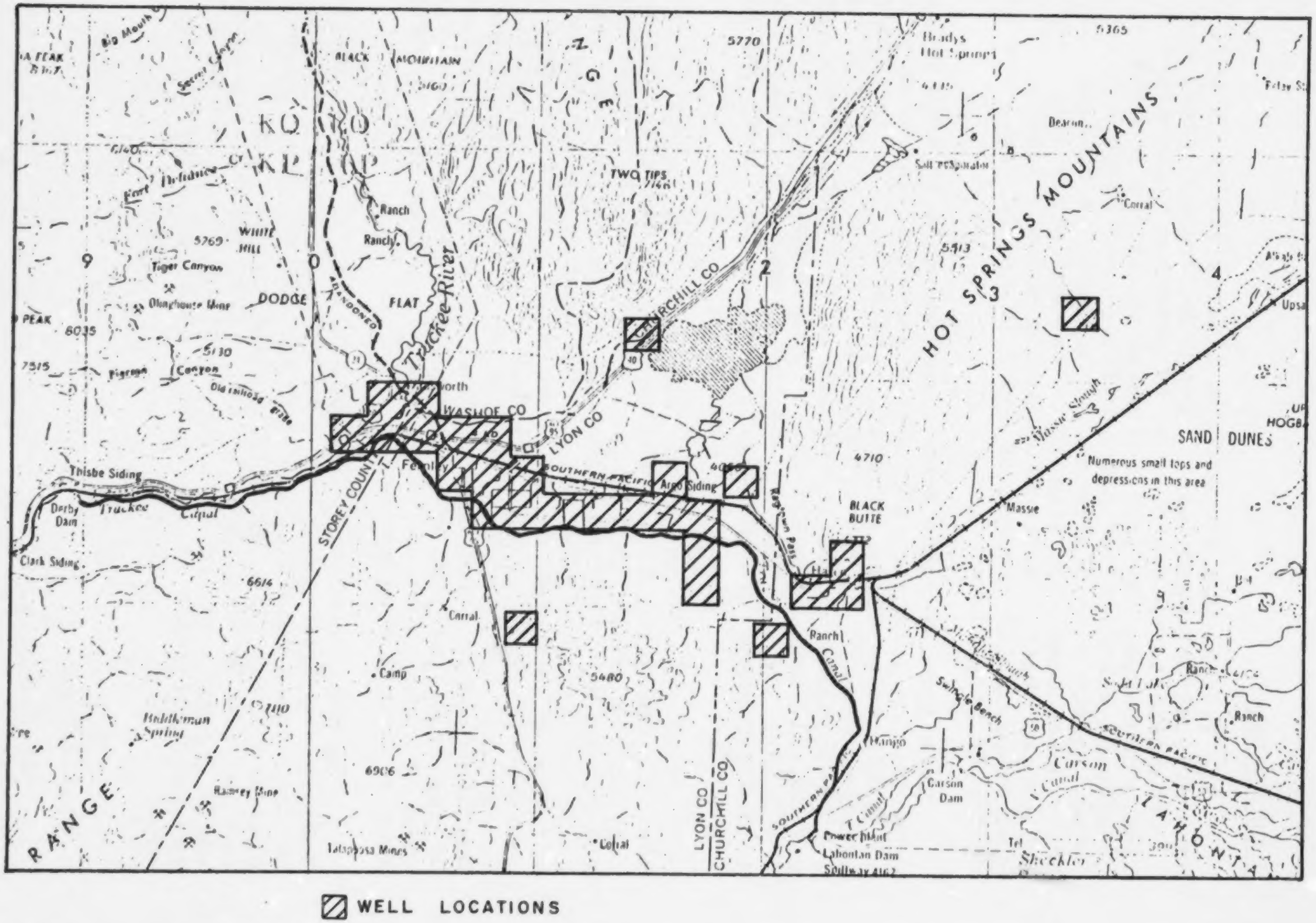


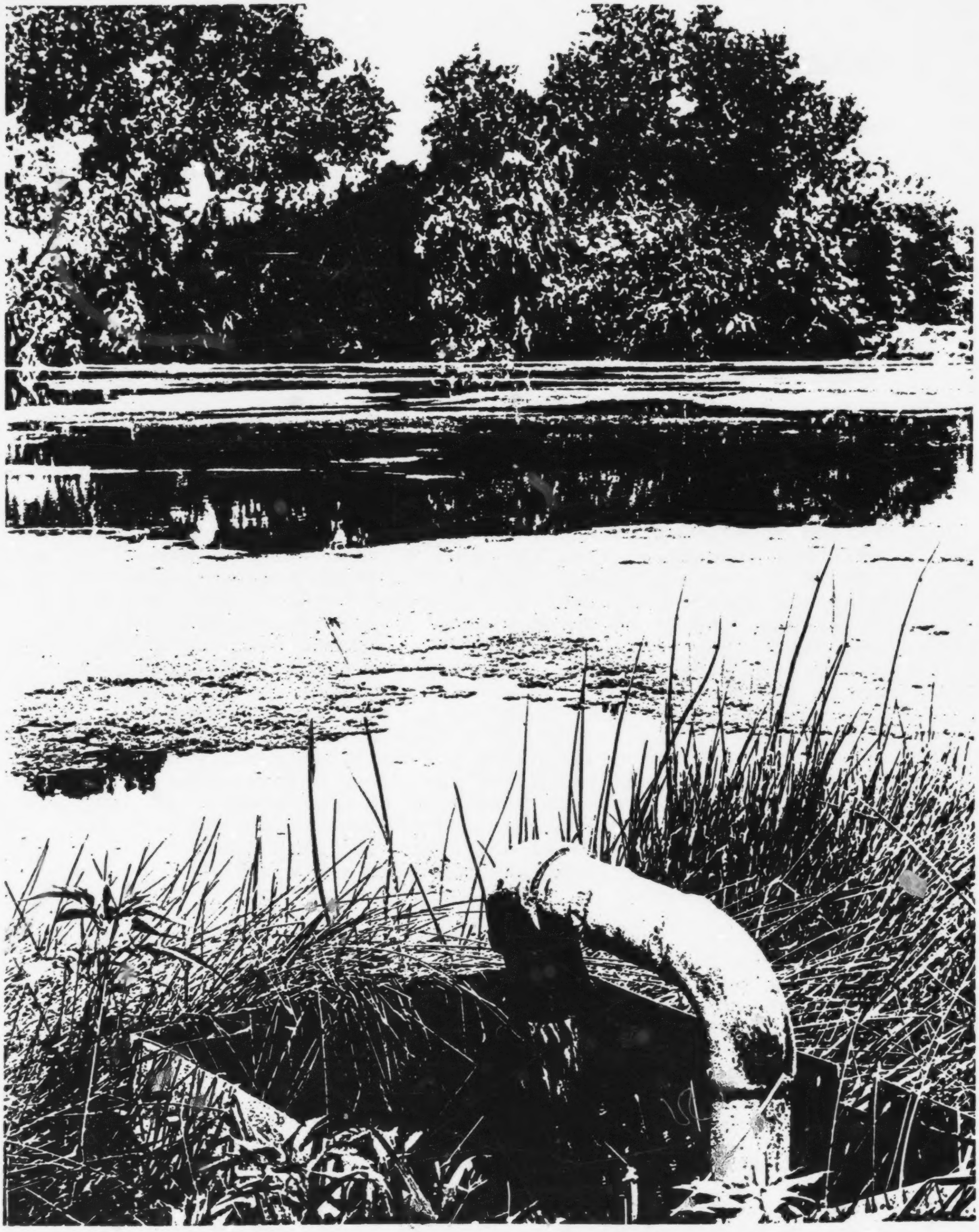
Table 5-25. Annual Contributions of Truckee Canal to Lahontan Reservoir Outflow

Year	Truckee Canal Inflow (AF)	Lahontan Reservoir Outflow (AF)	Percent of Inflow to Outflow
1973	103,406	306,154	34
1974	75,268	317,257	24
1975	104,422	333,740	31
1976	140,808	53,358	264
1977	111,841	51,918	215

SOURCE: USGS and TCID data.

directly from the canal for domestic use. Diversion and distribution to about 20 customers is accomplished by a private water company. The water is untreated. The water right for a reported 200,000 gallons per day is expected to support future residential and commercial development in Hazen. Drinking water quality standards for coliform bacteria, nitrate nitrogen and ammonia nitrogen will probably be exceeded. Other potential effects are not defined. During times when river water is not being diverted into the canal, flow in the canal would be totally comprised of treated sewage. Although the effluent would be disinfected the risk for contamination and disease infection would be substantial.

Table 5-23 shows dilution ratios in the Truckee Canal under 288 and 406 criteria, and projected constituent concentrations in the canal. The drinking water nitrate standard (assuming all nitrogen is present as nitrate) is 10 mg/l. Table 5-24 shows that under average conditions, the nitrate standard would be violated in August through May under the 288 criteria, and would nearly be violated December through February under the 406 criteria. This would occur under average water year conditions. Under historical low water year conditions, there would be no dilution of effluent with river water, and nitrate concentration in the canal would be 21.5 mg/l under both 288 and 406 criteria. Thus, nitrate would exceed the drinking water criterion in the Hazen domestic supply much of the time. The potential impact would be an increased risk of methemoglobinemia in infants. This analysis assumes all ammonia would be nitrified to nitrate by the time it reaches Hazen and there would be no biological uptake of inorganic nitrogen.



Hazen Water Supply Pool.

Cultural Resources

Based on the preliminary pipeline route, construction, maintenance and increased human activity could disturb three prehistoric sites (26Wa2, 26St27, and 26St5), of which two have National Register potential. One petroglyph site located on cliffs along the Truckee River (26Wa1601), with National Register potential, also appears to be located very close to the proposed pipeline. In addition, two other prehistoric sites (26Wa2679 and 26Wa2131), one of which has National Register potential, are located in the vicinity of the proposed pipeline and could be affected by increased human activity in the area. Because land to be irrigated with effluent in the Fallon area is already under cultivation, no cultural resources should be disturbed by this operation.

Land Use

The primary direct land use impacts associated with Alternative L-1 will be from the placement of 17.4-mile, buried pipeline from the JWPCP to Derby Dam. Conflicts with existing industrial facilities or residential development should not be a problem. Only three major areas of development are located adjacent to the river between Vista and Derby Dam: the Tracy power plant located between Patrick and Clark, a cement plant, and developments near Lockwood. The preliminary pipeline route appears to avoid the developments in the Lockwood area and the cement plant and runs between facilities and the river at the Tracy power plant site. Few other structures are located near the river and property lines often are not riparian (Cooper and Associates, 1980a). Some landowners along the river have expressed interest to develop their property some time in the future. If development was allowed to occur on land through which the pipeline crosses, the easement will only preclude structures being constructed directly over the pipeline and will not otherwise limit development.

Some land, the majority of which is located between Lockwood and Patrick, is cultivated along the Truckee River between Vista and Derby Dam. Based on the preliminary pipeline route, it appears the pipeline could cross cultivated lands between Lockwood and Mustang near Patrick. In these areas, the final design of the pipeline alignment must be consistent with agricultural features, i.e., subsurface drains, growing patterns and the owner's convenience. Presence of the pipeline, with proper design and construction, should not preclude the use of the land for agricultural purposes. Crossings of irrigation canals and laterals can be accomplished outside of their times of use for irrigation by normal trenching (Cooper and Associates, 1980a). After construction, the presence of the pipeline should have little effect on canal operation. Concrete pads over the pipeline to protect the pipe during canal cleaning and special impervious backfill of the banks to prevent canal leakage will be provided (Cooper and Associates, 1980a). Because the pipeline will be buried, there should be no conflict with livestock grazing.

After construction of the pipeline is complete, the presence of the buried pipeline should not directly affect recreational uses of this area. Should riparian habitat be disturbed, however, recreational uses could be secondarily affected by potentially reduced wildlife populations and aesthetic values.

Railroad crossings, of which three are planned, will be constructed in jacked casings so as not to interrupt train operation (Cooper and Associates, 1980a).

Institutional Concerns

Disposal to the Truckee Canal raises many institutional questions from water ownership to canal maintenance. Agreement between the cities and TCID would be the minimum institutional arrangement necessary for implementation of Alternative L-1. However, the WPRS is likely to become involved, since the discharge amounts to a guaranteed annual diversion to the Newlands Project regardless of hydrologic conditions, and WPRS promulgates these diversion criteria. Resolution of this issue is likely to become a complication of current litigation between WPRS and TCID.

The question of who owns the effluent is one aspect of this issue. If the cities own the water it may be determined that the 42,000 AFY of effluent can be in addition to TCID's rights to Truckee River water. This complicates the impact analysis, which assumes the effluent to be part of TCID's allotment.

The continuous discharge to the Truckee Canal presents potential problems for TCID. Does TCID own the effluent once it is in the canal, and if they do, are they responsible for any pollutants it contains? Questions of crop failure, crop damage, degradation of Lahontan Reservoir and public health are raised by this issue. TCID will also have a more difficult time maintaining the canal since it will always have some flow. If a storage reservoir is provided at the JWPCP, it may be possible to work on alternate days, although the canal would not be completely dry.

Public attitudes are also an element of institutional concern. Land owners along the Truckee River between Vista and Derby Dam are especially concerned about reduced flows, the ability to obtain sufficient water to satisfy their water rights and to irrigate their fields, and the ability to satisfy the water quality and quantity needs of the designated Truckee River beneficial uses, if the effluent is removed from the river and piped to the Truckee Canal. Fallon residents were concerned about the effect that discharging effluent directly to the Truckee Canal would have on the water quality of Lahontan Reservoir; accumulation of salts, phosphorus, nitrogen and heavy metals on soils irrigated with effluent; contamination of domestic wells, and public health.

Acquisition of a satisfactory pipeline easement may be time consuming. Resistance may occur where the pipeline easement crosses private land and may necessitate revising the alignment. Acquisition of easements through lands owned by the federal government or other institutions, on the other hand, should not be difficult.

Energy

The Facilities Plan (Kennedy/Jenks, 1980) contains insufficient data to quantify energy use of the Truckee Canal alternative. This alternative involves a treatment process that is less energy-intensive than AWT with Truckee River disposal, and involves gravity discharge. It should have the least energy consumption of the three alternatives.

Mitigation of Truckee Canal Disposal Impacts

- Reduction of mean annual flows between Steamboat Creek and Derby Dam by about 8 percent.

This impact can be mitigated by leaving the effluent in the Truckee River. It can also be mitigated by reducing consumptive losses in the basin (see Mitigation of Dodge Flat Impacts section); reducing water exports; or importing water to the basin. All mitigations except removal of effluent from the river would increase the flow to Pyramid Lake above present conditions.

- Reduction in low Q_{10} flows of up to 28 percent.

Each of the foregoing mitigations could eliminate this reduction. Also, it can be mitigated by revising river management criteria to enable upstream storage of more water to augment flows in low flow periods. Many institutional questions would need to be resolved in order to implement this mitigation measure.

- Increased concentration of background pollutants in Truckee River between Steamboat Creek and Derby Dam due to flow reduction.

This impact can be mitigated by providing flow augmentation during low flow periods to protect water quality. This requires a change in the river management rules, which is a difficult problem to resolve among the many affected institutions.

This impact can also be mitigated through reduction in background pollutant loading, particularly from various Truckee Meadows sources. The WCOG, through its 208 plan implementation, is pursuing various mitigations to reduce nonpoint source pollutants in the Truckee Meadows area. Progress toward improvements in quality should be systematically monitored.

- Increased pollutant loads and increased algal growth in feeder canals and storage reservoirs fed by the Truckee Canal.

Advanced waste treatment, including nitrogen and phosphorus removal, prior to discharge would mitigate this potential problem. Removal of the discharge from the canal would also be an effective mitigation.

A structural mitigation to protect the reservoir could be implemented to divert all nonirrigation season flows from the canal to the lower Carson River. Although by-passing the reservoir would benefit the reservoir it could constitute a significant adverse impact on the lower Carson River. This mitigation may also impair existing water rights and contracts. Data have not been developed to analyze the consequences of this option.

- Toxicity to fish in the Truckee Canal and Lahontan Reservoir, and nutrient build-up in Lahontan Reservoir.

Advanced waste treatment, including nitrogen and phosphorus removal, filtration, chlorination and dechlorination prior to discharge would adequately mitigate this problem. Dechlorination may need to occur at the discharge point to reduce odors and prevent chlorine toxicity. Removal of the discharge from the Truckee Canal would also effectively remove this source of toxicity and nutrients.

- Pollution of lower Truckee River and threat to cui-ui due to spills and seepage from Truckee Canal.

This impact can be eliminated by constructing a reregulation structure in the Truckee Canal prior to introduction of the effluent. In this way the flow in the canal can be reduced to the quantity needed for the Newlands Project at the head of the canal. Seepage could then be eliminated by lining the canal. However, lining the canal prohibits groundwater recharged from this source, diminishing well yields and affecting beneficial uses associated with canal seepage established since construction of the Truckee Canal.

Alternatively, the effluent would be piped an additional distance (up to 10 miles) before introduction to the canal, avoiding spills and canal seepage, and eliminating the need to line the canal.

Additional waste treatment would also reduce the severity of this impact.

- Substantial increase in public health risk to Hazen.

This serious risk could be mitigated by changing to a source of water totally free of effluent. Alternatively, Hazen could develop local groundwater sources and treat to remove any objectionable constituents (such as nitrate from canal seepage) and to disinfect the water. This impact can also be mitigated by discharging the effluent to the canal downstream of Hazen or by removing it from the canal entirely.

- Increase in public health risk to groundwater supplies in Fallon, Fernley and Wadsworth areas.

This impact can be mitigated by treatment of the water supply; advanced waste treatment of the effluent prior to discharge; providing an alternative water supply; or removing the effluent from the canals which recharge the respective groundwater areas. Monitoring of well water quality should be required.

Impacts of JWPCP Sludge Handling and Disposal

The sludge disposal element of the JWPCP would increase the sludge disposal capacity from 20 mgd to 40 mgd. The facilities are common to all alternatives, including no action (ESP). The sludge disposal facilities, of Alternative S-12, selected by the Cities of Reno and Sparks, would consist of an 8-inch diameter pressure pipeline from the JWPCP to Spanish Springs Valley. At Spanish Springs Valley, the sludge will be spread on 255 acres of a 460-acre dedicated disposal site. Spreading will only occur during 9 months of the year, with application rates of less than the evaporation rates. The sludge received during the remaining 3 months will be stored and applied during the remainder of the year.

Sludge Pipeline Impacts

Fish and Wildlife. It is assumed that the pipeline to Spanish Springs Valley will be buried. The pipeline will cross the Truckee River once. Riparian and aquatic life will not be affected by the presence of the pipeline except if a ruptured pipe allows spillage into the river. During conditions in which the pipe was unearthed and ruptured, such as during seismic activity, liquid sludge could be discharged into the Truckee River at the river crossings. In such an event the majority of pollutants would be flushed down the river and diluted in a relatively short period, although some nutrients and toxic materials could settle into bottom sediments thus potentially inhibiting fish spawning, encouraging the excessive growth of aquatic plant species and impairing benthic invertebrates in the river. The magnitude of effects would be related to river flow at the time. The impacts could be significant and cause fish kills at lower flows. Because the Truckee River system is closed, these events would allow for a greater accumulation of nutrients, salts and toxic substances in Pyramid Lake and Lahontan Reservoir, thus affecting these ecosystems, although the possible risk for such events to occur is judged to be low. Warning systems for pipeline rupture should diminish impacts. Emergency storage capacity should be available for any disruption of the conveyance system. The Facilities Plan recommends retaining several sludge drying beds for emergency storage.

Depending upon the exact location at which the pipeline crosses the river, riparian trees and brush could be affected. The diverse vegetation characteristic of riparian areas supports concentrated and diverse wildlife populations. Also, the endangered bald eagle infrequently uses the Truckee River corridor (Herron, pers. comm.). Because the Truckee River supports one of the few riparian communities in the state, the pipeline should be routed to ensure the protection of this habitat.

Cultural Resources. Several sources are located in the vicinity of the pipeline route north of Sparks, based on the cultural resources reconnaissance surveys conducted by the Nevada Archeological Survey in 1976 for EPA, and by DRI in 1980 for the City of Reno. The pipeline parallels Spanish Springs Road which borders the eastern edge of the marsh in southern Spanish Springs Valley. A nearby, continuous scatter of artifacts exists between the road and the marsh for at least 2 miles in T20N, R20E, sections 22, 15, 14, 11 and 12. Included among these artifacts are approximately 300 grinding stones. This high concentration of artifacts suggests that this area was a major winter village site and that seed processing was also an important activity here.

During the design phase of this project, a 100 percent cultural resources survey would be required for the pipeline routes to ensure that no historic or prehistoric sites would be damaged or destroyed. Most or all sites can probably be avoided by the pipeline if it is placed along the east side of the road, beneath the existing roadway or in the drainage ditch (EPA, 1977). If this is not possible, however, the disturbance of any cultural resources can be mitigated.

Seismic Hazards and Accidents. The proposed pipeline route to Spanish Springs Valley does not cross a fault; however, it is located in the proximity of many faults (Nevada Bureau of Mines and Geology, 1969). Damage to the pipeline could occur should a shock be centered in any of these nearby faults as well as by any large regional shocks. Pipeline failure, allowing liquid sludge to spill into the river, would significantly degrade the water quality and beneficial uses of the river and pose risks to public health.

Aesthetics. Because the pipeline will be located in previously disturbed areas and will probably be buried, little, if any, visual disruption should occur following construction.

Energy and Chemical Use. Electrical energy will be required to pump the liquid sludge from the plant to the disposal site. Energy required for sludge conveyance will be approximately 660,000 kwh per year.

Reliability and Flexibility. Reliability is a function of the number and complexity of pumping stations and the overall length of the pipeline. Pumping station reliability can be increased by providing standby equipment. Standby pumps will be provided for use during failure of a pump or during normal maintenance of a pump. Standby power generators to overcome power outages are not planned. Pipeline reliability, assuming proper initial construction, can be best equated to pipeline length; the longer a pipeline the lower its reliability. Pipeline failures are due to failure of the pipe, failure of a joint between two pipes, failure resulting from natural causes (such as an earthquake) or failure by man-induced causes (such as rupture during construction of some other facility). The pipeline is considered to be satisfactorily reliable if storage and standby facilities are included in the design.

Pipeline conveyance is relatively inflexible, because there are no alternative conveyance methods available on short notice. If for some reason the sludge conveyance pipeline could not be used, no other transport method could be immediately implemented, and storage would have to be relied upon until the conveyance facilities could again be utilized.

Spanish Springs Sludge Disposal Site Impacts

The following section discusses the potential impacts of sludge disposal.

Water Quality and Quantity Implications. The JWPCP is currently employing subsurface injection of liquid sludge on city-owned property in the floodplain adjacent to the JWPCP. Sludge disposal at Spanish Springs Valley can significantly reduce the risk for surface or groundwater quality degradation, public health and degradation of downstream beneficial uses.

Sludge will not be discharged to any surface waters or to lands within 0.25 mile of any surface water. Thus, potential water quality problems associated with sludge disposal will primarily be related to groundwater, the movement of leachate through the soil and surface runoff to drainage systems.

Application of sludge for 9 months of the year at an annual rate less than the average evaporation rate is proposed. Given the permeability of the soil, this rate should provide ample time for evaporation of the water associated with the sludge and minimize the percolation of water to the hardpan. Percolation and runoff problems may occur, however, due to short-term variations in climate. After storage of sludge for the 3 winter months, the ponds will be emptied by spraying the stored sludge mixed with the influent sludge during the remaining 9 months of the year. Due to lower evaporation rates during the late winter and early spring months, it may take 1 or 2 months to empty the ponds, allowing liquid sludge to stand in the ponds for several months.

The standing water in the ponds could induce infiltration and percolation to the hardpan during the storage period. This water may then move laterally through the soil or create a perched water table. If upon detailed examination of the site this problem seems likely to occur, it can be eliminated by compaction or lining the storage ponds to prevent infiltration into the soil.

Rain storms may prove to have the greatest impact upon the disposal of sludge. For example, a long winter may necessitate the storage of sludge for more than 3 months.

Long or intense rainfall and snowmelt may cause the leaching of nutrients and metals from the applied sludge into the soil and potentially move off the disposal site. The amount of leaching and quality of leachate will depend in part on the size and duration of storms, the stability of sludge constituents, and subsurface water flow. The slow to moderate permeability of the soil should tend to inhibit percolation during storms but soil condition may be insufficient to deter percolation during longer duration storms. Surface runoff, which could carry portions of the applied sludge overland and eventually to a receiving water, should be controlled by the use of berms or control structures, designed to trap and retain any runoff.

The characteristics of any leachate that percolates to groundwater will depend on sludge constituents and the filtering ability of the soil. The distance between the disposal site and the groundwater discharge zone (approximately 1 mile) may provide adequate filtration of any leachate. However, there are soils in the area that are rapidly permeable which would provide little or no treatment of a leachate. Also, there may be breaks in the hardpan which could allow leachate to travel through the hardpan into the subsoil. This kind of event could pose water quality risks for nearby wells.

The sludge disposal method does not provide for beneficial reuse of the water associated with the sludge. The future use of this water, totaling 354,000 gallons per day (396 acre-feet per year), will be lost.

Fish and Wildlife. Use of Spanish Springs Valley for sludge disposal will necessitate removal of natural vegetation for buildings, application areas, berms, roads and other facilities. Up to 460 acres of vegetation could be lost. Predominant vegetation of the site is big sagebrush, bottlebrush squirreltail, and cheatgrass. Resident wildlife species including subsurface dwelling and sedentary mammals and reptiles would be lost. The area is relatively small and does not support a large wildlife population, therefore, the direct impact to wildlife is expected to be total on the site but minor on a regional basis.

The wetland area in Spanish Springs Valley supports a larger concentration and diversity of wildlife than the surrounding arid lands. Application of sludge on land as close as 0.50-1 mile from the wetlands could influence wildlife using that area.

Leachate from the disposal of liquid sludge at the site could percolate through the soil and be discharged at these wetlands. These wetlands receive heavy use from waterfowl and, as a result, are typically enriched. Leachate discharged in this area should not significantly affect the biota associated with or using these wetlands (Sumner, pers. comm.).

Cultural Resources. Sludge disposal will impact several known sites of cultural resources. A 1980 field survey by DRI located 56 artifact sites within the disposal parcel. Some of the features, such as a small rock dam, are rare, and the total impact of the project on these sites has not yet been evaluated. To minimize disturbance and loss of any such resources by construction, the following procedures are recommended. On the basis of the detailed inventory, observed cultural resource sites should be categorized according to site type and suspected potential to yield subsurface cultural remains. Each category of site then could be sampled by test excavations to establish the actual existence of buried cultural remains. Those site types yielding buried cultural remains would require further excavation. Those site types lacking subsurface remains could be mitigated against any adverse impact by insensitive surface collections. Finally, because it would not be economically nor scientifically practical to mitigate every archeological site in the study area, it is recommended that only a sample of all sites be collected and/or excavated.

Seismic Hazards and Accidents. The proposed Spanish Springs Valley sludge disposal site will be located directly on a concealed fault which begins in the Spanish Springs Canyon and extends for a short distance onto the valley floor.

Should a major shock occur at the site, significant damage to the storage basins could occur, allowing spillage of liquid sludge. An event of this type could adversely affect water quality, beneficial uses and public health, depending on the amount of sludge reaching surface streams of water supplies. Storage basins should be designed to withstand major earthquakes, and surface runoff controls constructed to avoid or minimize risks to public health and water quality should a reservoir fail.

Aesthetics. The aesthetics of sludge disposal are, in part, dependent upon the locations of disposal areas and the methods of application. The remoteness of the Spanish Springs Valley sludge disposal site tends to reduce the problem of adverse aesthetic impacts. Aesthetic concerns could increase in the future with the development of nearby areas. The sludge storage and pumping facilities at the site will be designed to have a low profile to reduce visibility. Landscaping with trees and shrubs, utilizing the sludge as a water source, will further conceal the facilities and provide a barrier to mitigate the spreading of odors and aerosols. Buffer zones between sensitive receptors (e.g., residences, businesses and public roads) and lands where sludge is applied would reduce any possible aesthetic impacts.

Odor. Digested or stabilized sludge in liquid, slurry or dried cake form will not emit strong, offensive odors if properly handled. It does give off a slightly earthy smell which is considered by many people to be inoffensive.

Minor odor problems could exist in the immediate vicinity of the storage reservoirs. Odors from land application can be minimized by controlling the loading rates to avoid causing the soils to become anaerobic.

Public Health. A major objective of all wastewater treatment and disposal systems is to remove existing threats and to lower risks to public health. In this case, the alternatives for sludge treatment and disposal are being evaluated relative to the current use of subsurface injection of liquid sludge on the city-owned property adjacent to the JWPCP and the river.

Potentially, the most direct effect to public health would be from the spray disposal of liquid sludge. Spray disposal of digested liquid sludge can create a health risk to persons on or adjacent to the disposal area. Pathogenic agents (virus, bacteria) found in digested sludge can cause illness or disease if ingested by humans. The two most typical means of infection are inadvertent ingestion of wastewater or inhalation of wastewater aerosols created during spraying. Inadvertent ingestion (e.g., drinking) can be effectively avoided in most cases by fencing disposal areas and posting signs that warn of the hazard. All water spigots, pipes and nozzles can be marked with warnings. The site can also be designed to keep surface runoff from leaving the area. The chance of persons accidentally or intentionally wandering onto a spray site can also be reduced by selecting an isolated disposal area. The land surrounding the site is used primarily for grazing with very few residences located nearby.

The health risk from aerosols is more difficult to control. Isolation and fencing of the spray area is the most effective safeguard. The nearest developments are a farmhouse located about 0.25 mile from the disposal site and several residences 1-2 miles north of the disposal site. Additional protection can be achieved by a variety of operational measures. All waste should be properly disinfected prior to irrigation; low trajectory and low pressure sprinkler heads should be used to keep fine aerosols from forming and drifting off of the site; and irrigation should cease during periods of high winds.

Direct discharge of treated sludge to any surface waters is not proposed. However, surface water quality can be affected and public health risks created under certain circumstances. Pipeline failure as a result of natural or man-related circumstances could allow the spillage of sludge containing pathogens and toxic substances into surface waters; potential lateral movement of liquid sludge through soil could allow pathogens to surface at the groundwater discharge area located downslope of the site or to contaminate local wells.

Vectors attracted to sludge can carry viruses and bacteria to other areas, thus posing a threat to public health. Studies conducted in Solano County, California (San Francisco Bay Region Wastewater Solids Study, 1977), indicated that when freshly digested sludge is surface-applied to land, flies and other insects are attracted, but in small numbers when compared to undigested organic wastes. Sludge applied in a dried form is not as attractive to insect pests. Additionally, liquid sludge that has dried on the surface does not attract insects as much as does liquid sludge. Sludge applied too thickly on the land poses the greatest potential for vector problems. Under proper moisture conditions, house flies may lay eggs in the undried sludge. With proper application rates, vectors and pests should not be a problem with the viable alternatives.

Soils. Sludge disposal will have a dramatic impact on a wide variety of soil characteristics because of its high loading rate. The most important impacts are from the addition of phosphorus, nitrogen, and heavy metals to the soil. Table 5-26 presents a projection of the annual amounts of nutrients and heavy metals which would be added to the soil. Because disposal will occur on dedicated land not being used for agriculture, addition of these constituents is not regulated by any agency guidelines or requirements.

Other impacts on soil are an improvement on soil tilth and moisture retention capability. These parameters are difficult to quantify, but the overall impact is indicated

Table 5-26. Annual Addition of Constituents to the Soil

Constituent	Pounds/Acre/Year Added Alternative S-12
Phosphorous (as P)	4,544
Nitrogen (NH_4^+ as N)	3,696
(Organic N as N)	5,808
(NO_3^- as N)	20.8
(TKN as N)	9,504
Chromium	9.5
Copper	63.4
Zinc	116.2
Cadmium	2.1
Lead	29.6
Nickel	10.6

SOURCE: Kennedy/Jenks, 1980.

by the depth of sludge soils which are added per year, as well as the weight of sludge solids added per year. Solids added to the soil will increase soil depth 0.4 inches per year and weigh 53 tons per acre per year.

Energy and Chemical Use. Energy will be required to pump sludge from the storage lagoons to the application system, and also to incorporate the sludge into the soil. Electrical requirements for pumping will be 63,500 Kwh per year. Discing at least once per year will be required to incorporate the sludge, but regulatory agency requirements may require more frequent discing. At least 60 gallons of diesel fuel would be used to disc the site.

Reliability and Flexibility. The reliability of disposal method is high, because the disposal operation is not mechanically intensive (some pumping is involved) and because it will utilize land for ultimate disposition.

Land Use. The disposal site will have to be rezoned A7, one dwelling unit per 40 acres, to allow sludge disposal. Application for a zoning change and use permit has been made to the county. The zoning change has been approved by the Planning Commission. The County Commissioners will vote on the applications August 14, 1980.

Application has been made to BLM to lease its parcels at the disposal site. Private land at the site has been appraised; landowners have indicated a willingness to sell their affected property.

Cost. Total cost for sludge disposal in present worth is: $7.71 million for AWT Master Project alternatives; $6.06 million for land application Master Project alternatives. Annual operation and maintenance costs account for $0.109 million of the total.

IMPACTS OF NO ACTION (ESP CONDITIONS)

The impacts of no action reflect the conditions that would exist at the completion of the ESP. These conditions are defined in Chapter 4 and summarized in this section.

There would be no construction impacts and the ESP would not affect the quantity of flow in the Truckee River. Water quality would be improved, primarily through phosphorus removal, although nitrogen loads would be higher than at present. AGP would be decreased through phosphorus removal, and DO levels would be increased. Total nitrogen loading to Pyramid Lake and Lahontan Reservoir would be increased over current levels.

The higher nitrogen levels could lead to an increase in nitrate in recharge to wells along the Truckee Canal. Higher nitrate levels in Hazen's surface water supply and the Fernley, Fallon and Wadsworth well supplies could result. An adverse public health impact would result if nitrate levels exceeded 10 mg/l.

Growth from about 150,000 (1979 population for Truckee Meadows) to about 231,000, assuming a 130 gpcd sewage generation rate, persons would occur due to the no-action or ESP option. This growth will place additional pressure on urban services, promote land use changes including loss of prime agricultural lands, impact air quality, and cause other growth-related impacts. These growth impacts would be similar to, but less in magnitude, than those described in the following section on common impacts.

The PEL data are a good indication of current quality conditions in the Truckee River. By the end of the ESP these conditions will be amended somewhat by the expansion and modification of the treatment process. The implementation of chlorine removal to meet an effluent standard of 0.01 mg/l will mitigate a major source of acute toxicity in the mixing zone. Pollutant loading to the Truckee River following the ESP was estimated using the background conditions measured by PEL and the projected effluent quality. The resultant average annual pollutant loads below the outfall are shown in Table 4-22.

Under no-project conditions toxicity levels in the zone of mixing should be greatly reduced and the habitat should improve, allowing regular use by sport fish and other organisms now excluded from the zone. Downstream habitat improvement depends on the effectiveness of phosphorus removal in reducing periphyton growth and associated DO problems. Nitrate and nitrite toxicity is expected to increase as the load of these toxicants increases with the magnitude of discharge from 20-30 mgd.

Between Vista and Derby Dam, orthophosphate concentrations will be reduced due to ESP phosphorus removal and uptake by aquatic organisms. Nitrites and ammonia will be reduced in concentration below the discharge because of natural nitrification processes. The potential for toxic conditions will decrease in a downstream direction.

Conditions in the lower river under the ESP would reflect a phosphorus-limiting condition, with nitrogen in excess. Phosphorus concentrations will be at or near background levels for most of this reach. This occurs as a result of nutrient uptake in the Vista to Derby Dam reach and within the Derby Dam to Pyramid Lake reach. Total phosphate and total nitrogen loading under ESP is shown in Tables 5-2 and 5-3. Salt and chloride loads will increase in this reach due to seepage and direct return of agricultural waters and leachate from surrounding soils.

Currently, nutrient uptake into plant growth is a major process in this reach. The reported concentrations of nitrogen and phosphorus decrease to background levels by Nixon. Algal growth, it is thought, will still decrease from existing levels with the ESP. Nitrogen will still be in excess of algal needs and phosphorus will be the controlling nutrient in the lower river.

The no-project (ESP at 30 mgd) should not appreciably affect the amount of water reaching Pyramid Lake if water use rates continue as in the past. It will account for less than half of the total phosphorus load under the ESP, and will account for most of the nitrogen load.

In the Truckee Canal, nitrogen will be in excess with phosphorus limiting. Present loads at the terminus of the Truckee Canal for total nitrogen and phosphorus are 1,947 and 468 pounds per day, respectively. Under ESP conditions, total nitrogen and phosphorus loads will be from 710 to 2,183 pounds per day and 19 to 60 pounds per day, respectively. The actual load will depend on whether the 288 or the 406 criteria are adhered to. These calculated loads for total phosphorus reflect the phosphorus removal characteristics of the ESP. Algal growth in the canal should be slightly less than current conditions because of the phosphorus limitations.

The increase in nutrient loading associated with the ESP is expected to increase algal production in Lahontan Reservoir, however, any quantitative estimate about the magnitude of increase must await the preparation and verification of a nutrient budget and algal growth model specific to Lahontan Reservoir.

The increased nitrogen loads in the Truckee River, Truckee Canal and Lahontan Reservoir may lead to increased nitrate levels in public and private water supplies. Hazen, which relies on untreated Truckee Canal water, and Fernley, Wadsworth and Fallon, which rely on wells that are recharged by Truckee Canal water, may experience an increased public health risk from an increasing proportion of effluent in the supply source.

The ESP will accommodate growth in Truckee Meadows, and hence will indirectly impact air quality through increases in pollutant emissions. The ESP will not accommodate growth in excess of what it is accounted for in the Truckee Meadows AQIP. As long as the ESP does not significantly increase the rate of growth in the Reno/Sparks area, air quality impacts of growth will be mitigated by measures currently adopted in the AQUIP.

Most, if not all, of the irrigated agricultural lands in the Truckee Meadows can be considered prime farmland under the foregoing definitions. Much of the presently unirrigated acreage may also be considered prime or potentially prime, depending on availability of water for irrigation. The SCS in Reno is in the final processes of determining which lands in the study area warrant the prime agricultural land designation (McDoughal, pers. comm.). An accurate estimate of the quantity of prime agricultural land (acreage) that will be converted is impossible at this time. However, in Table 5-2 it can be seen that the ESP capacity will result in the conversion of about 25,270 acres of the land to urban use, of which 5,050 are presently irrigated.

Comparison of Significant Environmental and Cost Considerations Relative to the Selection and Implementation of the Reno-Sparks JWPCP Master Project

The affected environment and no-action alternative conditions, as represented by the 30 mgd ESP, were described in Chapter 4. The environmental impacts of the three major Master Project wastewater treatment and disposal alternatives and the proposed sludge conveyance and disposal project were identified and discussed in Chapter 5. These alternative projects provide distinctly different sets of environmental, cost, and institutional conditions from which to select an implementable Master Project. The options to achieve similar goals are wide ranging and complex, creating benefits and detriments to numerous special interests. Consequently, the selection of a 40 mgd Master Project will require natural resource and economic trade-offs that are unique to the Truckee-Carson River basins. Potential mitigations for significantly adverse impacts are also identified in Chapter 5, but the responsibility and authority for initiating these and other mitigations are left as open questions. Mitigations leading to generally acceptable trade-offs depend on many decisions outside the purview of the EPA. Moreover, many of the required decisions are presently clouded by litigation and local customs.

The principal impacts of the Master Project, in common and as distinct alternatives, are summarized for comparative purposes in Table 5-27. The wastewater treatment and disposal alternative that seems to best resolve each stated issue for a resource category is also given in the table. The alternatives were selected to respond differently to the major issues, and of course, none provides a clear cut resolution to even a majority of these issues.

The Draft Facilities Plan prepared for Reno and Sparks by Kennedy/Jenks (1980) recommends the implementation of Alternative L-1, secondary treatment plus phosphorus removal and filtration with discharge to the Truckee Canal. Obviously implementation of Alternative L-1 or any of the other alternatives results in major environmental resource, social, and economic trade-offs of importance to the many interested agencies and parties. Comments on the Draft EIS and Draft Facilities Plan are expected to elucidate the significance and value of these trade-offs, and focus the governmental grant funding and regulatory process on the actions required to implement a project.

The Draft EIS is a response to the recommended project and major alternatives to that project. There are a number of significant environmental resource and socio-economic impacts common to the increase in wastewater treatment and disposal capacity from 30-40 mgd. Some of these common

Table 5-27. Summary Comparison of the Environmental Consequences of Alternative Reno-Sparks JWPCP Master Projects

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
SURFACE WATER HYDROLOGY					
Effects on river flow downstream of Steamboat Creek	Urban growth and the conversion of irrigated agricultural land to urban uses could potentially reduce the annual river discharge by 0 to 5 percent	Except for secondary growth effect common to all alternatives there is no effect	Reduces annual river discharge at Vista by 8 percent Could reduce low Q_{10} monthly instream flows at Vista up to 65 percent depending on river operation criteria	Reduces annual river discharge at Vista by 8 percent Reduces low Q_{10} monthly instream flows at Vista up to 28 percent depending on river operations criteria	AWT with Truckee River disposal
Effects on flows passing Derby Dam to the lower Truckee River	Same as above	Same as above	Reduces annual average discharge past the dam by 8 percent and reduces low Q_{10} flows by up to 65 percent	Same as above	AWT with Truckee River disposal
Effects on Truckee River discharge to Pyramid Lake	Same as above	Same as above	Reduces annual average discharge to the lake by 9 percent. Could reduce average monthly low Q_{10} flows up to 73 percent	Would not change annual inflow to Pyramid Lake but average monthly low Q_{10} flows could be reduced up to 16 percent. Average monthly flows can increase or decrease depending on river operations from reservoir storage.	AWT with Truckee River disposal
Effects on Newlands Project water demand shortages	No estimated effect	No estimated effect	This option is estimated to increase agricultural demand shortages by 66-71 percent over the river disposal option	Reduces the risk of agricultural water demand shortages in the Newlands Project	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on inflow to Lahontan Reservoir	No estimated effect	No estimated effect	Could reduce amount of flow entering the reservoir but depends on river operations schedule	Produces up to 60 cfs inflow into reservoir during nonirrigation season	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on amount of water reaching Stillwater Wildlife Management Area	No estimated effect	No estimated effect	Estimated to reduce spillage from Lahontan Reservoir by 2-4 percent	Estimated to increase spills from Lahontan Reservoir by 20 percent	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
SURFACE WATER QUALITY					
Abatement of acutely toxic conditions in the Truckee River caused by the JWPCP	All Master Project alternatives remove or abate acutely toxic conditions caused by the JWPCP	At normal JWPCP operations and at river flows exceeding the low Q_{10} conditions acute toxicity is not expected to occur	The JWPCP effluent does not enter the river	Toxic conditions could occur below Derby Dam during treatment plant failures if effluent is released from the canal into the lower river	Secondary treatment and land disposal at Dodge Flat
Abatement of excessive eutrophication of the Truckee River and Truckee Canal	All Master Project alternatives reduce or remove the JWPCP nutrient load	The average daily total nitrogen load is reduced to river by 43 percent and to canal by 42-75 percent. The average daily total phosphorus load is increased to the river by 14 percent	The nutrient load from JWPCP does not directly enter the river; however, some nutrients may enter the river via groundwater accretions downstream of Wadsworth	The JWPCP nutrient load would be removed from the river between Vista and Derby Dam. The total nitrogen load below Derby Dam would be reduced by 22-43 percent. The total phosphorus load below Derby Dam would decrease by 34 percent The total nitrogen load in the Truckee Canal would increase by 122-146 percent The total phosphorus load in the canal would increase by 60-96 percent The Truckee Canal is expected to show symptoms of excessive nutrient enrichment	Secondary treatment and land disposal at Dodge Flat
Effects on dissolved oxygen (DO) in the river between Vista and Derby Dam	All Master Project alternatives reduce substances in the river that could cause depressions in DO	Oxygen consuming BOD and ammonia loads in the river are reduced Algal growth is reduced which in turn reduces the respiratory demand for DO	The BOD and COD load from the JWPCP is removed from the river	The BOD and COD load from the JWPCP is removed from the river between Vista and Derby Dam BOD and COD may be returned to the lower river The BOD load on the Truckee Canal will average 1.09-1.17 mg/l An oxygen sag is expected to occur in the Truckee Canal	Secondary treatment and land disposal at Dodge Flat

Table 5-27, cont.

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phosphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
Effects on chronic toxicity in the river and Truckee Canal	All Master Project alternatives remove or abate chronic toxicity in the river or canal. Nonpoint sources containing potential toxicants are not affected	Through treatment, choice of points of discharge, dilution and the assimilative capacity of the river, potential toxicants in the effluent are reduced to levels that are considered safe for fish as prescribed by the water quality standards There remains a risk for chronic toxicity to occur	The JWPCP which contains toxic substances will not be discharged to the river or canal An undefined level of risk for chronic toxicity to occur in the river will be present from other wastewater discharge sources	Toxic substances in the JWPCP effluent would not enter the river upstream of Derby Dam Toxic substances may enter the lower river by seepage and diversion from the Truckee Canal The level of risk for chronic toxicity to occur in the canal would be high	Secondary treatment and land disposal at Dodge Flat
Effects on bottom sediment characteristics in the river and Truckee Canal	Urban growth and construction is expected to increase the sediment load discharged to the river with surface runoff	Biological growth stimulated by nutrients cause sediments to have a greater content of organic material, higher BOD and lower interstitial DO	The organic component in bottom sediments would be reduced and average interstitial concentrations of DO would rise	Bottom sediments in the canal would have higher BOD and lower DO concentrations	Secondary treatment and land disposal to Dodge Flat
Effects on water temperature in the Truckee River	No common definitive effect	The JWPCP effluent is warmer than the river and may raise the river temperature in the mixing zone by about 1 to 2°C	No direct effect The secondary effect of reducing instream flow may also raise temperature in the warm season	Effect of pipeline conveyance on effluent temperature is undefined. Thus, the effect on temperature in the canal is not projected	Secondary treatment and land disposal to Dodge Flat
Effects on drinking water quality in the river and canal	Effects are specific to alternative	Improved chlorination and effluent filtration is expected to lower risk of infection. Increase in effluent volume may increase risk of chemical contamination	Sewage effluent would be removed from the river and significantly lower the risk of using the river as a treated drinking water supply	Although the river below Derby Dam would improve as a potential drinking water supply, the lower river would retain a high risk for periodic contamination, and the Truckee Canal would be significantly degraded	Secondary treatment and land disposal to Dodge Flat
Effects on water quality in Pyramid Lake	Urbanization is expected to increase the associated nonpoint source load of biologically active agents entering the lake. The impacts are undefined Decreased agriculture is expected to reduce the volume of irrigation return water and associated loads of salts, nutrients and suspended solids	At the time of conversion from the 30 mgd ESP to the Master Project the total nitrogen load could be reduced by 43 percent which could rise to a 16 percent reduction at 40 mgd. Reductions in nitrogen load are expected to cause the lake to continue to be nitrogen limited. Waste constituents not targeted for removal will increase in proportion to effluent volume	The total nitrogen load could be reduced by as much as 63 percent. The array of waste constituents associated with the JWPCP effluent would not enter the lake except for the groundwater return from Dodge Flat	The total nitrogen load could be reduced by 38 percent depending on how much is released from the canal to the lower river. A significant reduction in waste constituent loading would result.	Secondary treatment and land disposal to Dodge Flat
Effects on water quality in Lahontan Reservoir	Similar to above	The total nitrogen load could initially be decreased by 77 percent which diminishes to 45 percent at 40 mgd. The total phosphorus load could be reduced by as much as 95 percent from the present. The reservoir should be nitrogen limited	The total nutrient load would be reduced to the river base load. Reductions of 85-62 percent in total nitrogen and 97-93 percent in total phosphorus loads are expected to improve opportunities for beneficial uses impaired by excessive eutrophication	The total nitrogen load could increase over the present by 100-159 percent. There would be a significant decrease in phosphorus load from the JWPCP but phosphorus stored in the reservoir and entering with Carson River water may cause the increased nitrogen load to present excessive algal blooms to greater levels of unacceptability	Secondary treatment and land disposal to Dodge Flat
Effects on water quality downstream of Lahontan Reservoir	No significant effect expected	No significant effect expected	No significant effect expected	Depending on canal and reservoir operations there could be signi- effects	Secondary treatment and land disposal to Dodge Flat

Table 5-27, cont.

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
FISH AND WILDLIFE HABITAT					
Effects on fish habitat and fisheries between Vista and Derby Dam	Improve habitat and increase fishery potential	Abate acute and chronic toxicity Reduce algal growths Increase number of species of invertebrates Reduce DO sag in water and bottom sediments Support sport fish and a fishery	Remove JWPCP effluent from the river Reduce instream flow with potential significant impact on autumn and winter spawning fish Fish and aquatic invertebrate habitat similar in quality to that above Steamboat Creek Support sport fish and a recreational fishery	Similar to land disposal at Dodge Flat	Secondary treatment with land disposal at Dodge Flat or secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on fish habitat and fisheries between Derby Dam and Pyramid Lake	Same as above, plus Potential for a slightly lower instream flow due to urban growth	Similar to above	Similar to above, plus Potential for significantly lower average instream flows Potential incremental loss in cui-ui spawning and dispersion habitat Potential impairment of fish access to river from Pyramid Lake	Significantly reduces amount of JWPCP effluent entering the lower river Reduces algal growth Increases diversity of invertebrate species Moderate fluctuations in DO and pH Reduces organic content in bottom sediments Potential to change instream flow both beneficially and/or adversely	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on fish habitat and fisheries in Pyramid Lake	Potential to reduce inflow into lake and contribute to lowering of lake	Stabilization of eutrophication of lake Reduces total nitrogen and total phosphorus loading to lake Potential to increase load of salts and other solutes not removed by treatment process	Removes nutrient and other potential pollutants of JWPCP origin Lower average primary productivity Potential to improve DO concentrations in deep water Increase clarity of water Reduces salt load Reduces annual inflow of water by an average of 9 percent Contributes to lowering of the lake	Reduces nutrient and other potential pollutant load on the lake Maintains or lowers primary productivity in the lake Reduces salt load to the lake	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on fish habitat and fisheries in Truckee Canal	No effects identified	Reduce algal growth potential Reduce public health risk	Significantly reduces algal growth potential Significantly reduces public health risk Improves opportunity for recreational fishery	Cause acute and chronic toxic conditions for fish Cause excessive algal and other microorganism growth High risk for contamination of fish flesh Reduce species diversity	Secondary treatment with land disposal at Dodge Flat
Effects on fish habitat and fisheries in Lahontan Reservoir	No identified effect	Reduces nutrient load from JWPCP Potential to reduce algal growth Slow down eutrophication process	Significantly reduces nutrient and other pollutant load Reduce algal growth and perhaps raise DO in hypolimnion Improve aesthetics Improve fishery	Significantly increase nitrogen load which is judged to cause greater algal growth related problems Potential to cause toxic conditions near dam Adversely affect sport fish and fishing Impair aesthetics of recreational fishing	Secondary treatment and land disposal at Dodge Flat
Effects on endangered fish - cui-ui	Secondary growth effects of lowering instream flow and increasing nonpoint source pollutant load	Improves fish habitat in lower river Reduces JWPCP impact on Pyramid Lake	Significantly improves water quality in lower river Diminishes instream flow in lower river Potential to increase problem of spawning areas from lake to river Reduces quantity of river habitat Contributes to lowering of lake	Potential for catastrophic effects if JWPCP treatment fails and effluent is released from canal to lower river	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal

Table 5-27, cont.

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phosphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
Effects on threatened fish - Lahontan cutthroat trout	Same as above	Improves year-round habitat in Truckee River Improves spawning gravel quality Allow passage during coolwater season	Removes water quality effects of JWPCP between Vista and Pyramid Lake Reduces low Q_{10} instream flows and causes loss of flow related habitat Impairs passage from lake to above Vista	Causes toxic conditions for fish entering the canal Same as land disposal for habitat conditions from Vista to Derby Dam Potential for catastrophic event in lower river if JWPCP fails	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
Effects on wildlife	Secondary growth effects of converting wild and agricultural lands to urban and project uses	Potential loss of riparian habitat at outfall locations	Loss of 4,200 acres of native habitat Potential loss of riparian habitat along river	Potential loss of riparian habitat along river	AWT with Truckee River disposal
GROUNDWATER					
Effects on groundwater quality	No common effects	No significant effect expected	Excess irrigation will recharge groundwater, increase nitrates, leach salts from lake bed, eventually trigger poor quality return flows to Truckee River Quality degradation of Wadsworth area wells, and in wells near Fernley drain Rapid infiltration will lead to return flows to Truckee River within 10 years, returning JWPCP pollutants to river and Pyramid Lake	Percolation from canal to groundwater will degrade wells increasing nitrate levels and other constituents	AWT with Truckee River disposal
WATER SUPPLY					
Effects on water supply for M&I use	No common effects	Continuation of discharge of effluent to Truckee River and Truckee Canal, which is used as a direct water supply in Hazen, and an indirect supply from wells in Wadsworth, Fernley and Fallon	May contaminate wells used for domestic purposes in Wadsworth and near Fernley drain	Will degrade water supply for Hazen, and may degrade groundwater used for water supply in Fernley and Fallon	AWT with Truckee River disposal
PUBLIC HEALTH					
Effects on public health risks	Small risk of public exposure to pathogens from sewage treatment plant	Small risk of public exposure to pathogens from discharge to river	Risk of contact with aerosol particles from spray irrigation at Dodge Flat Risk of well contamination at Wadsworth from irrigation, rapid infiltration and Fernley drain discharge	Risk of contact with effluent in Truckee Canal, in Hazen's untreated water supply, in Lahontan Reservoir, and in lateral canals and reservoirs. Risk of well contamination near canal	AWT with Truckee River disposal
CULTURAL RESOURCES					
Effects on historic and archeological resources	No common effects	Disturbance of several sites on outfall alignment, depending on location	Disturbance of several sites on outfall alignment and loss of numerous sites at Dodge Flat. Site significance not determined	Disturbance of several sites on outfall alignment	AWT with Truckee River disposal
SOCIO-ECONOMICS					
Effects of growth on Truckee Meadows	Decreased agricultural acreage, decreased groundwater recharge, increased surface water diversions; increased demands on urban services; impaired ability to meet air quality standards; and other factors	All effects are common	All effects are common	All effects are common	No difference

Table 5-27, cont.

Resource Issue and Category of Effect	Impacts Common to Master Project Alternatives	Significant Impacts of Advanced Wastewater Treatment (AWT) and Truckee River Disposal	Significant Impacts of Secondary Treatment Plant-Land Disposal at Dodge Flat	Significant Impacts of Secondary Plant with Phorphorus Removal and Filtration-Discharge to Truckee Canal	Master Project Alternative with Beneficial or Minimum Adverse Effects
COST					
Effect on monthly sewer service charges	Increased costs	From \$2-\$7 per month cost increase	From \$2-\$7 per month cost increase	About \$2 per month cost increase	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal
LAND USE					
Effect of alternatives on land use	No common effects	No significant effect expected	Change in use of 4,200 acres at disposal site, and 640 acres at rapid infiltration site, plus minor impacts along outfall pipeline	No significant effect expected, except minor impacts along outfall	AWT with Truckee River disposal
ENERGY					
Relative energy consumption	Impacts are specific to alternative	Energy intensive treatment process	Energy intensive disposal method	Lowest energy use	Secondary treatment with phosphorus removal and filtration, and Truckee Canal disposal

impacts are adverse, and potential mitigations are identified, but not necessarily placed in action programs. For example, urban and recreational growth increase traffic, which increases air pollution, which increases the frequency of violations of air quality standards established to protect public health. The EPA, the state, and local government are involved in a program to mitigate the emissions of air pollutants to reduce the frequency of air quality violations. The current plan does not account for the total growth that may be accommodated by the Master Project.

Other areas of secondary impact related to growth are the conversion of potentially prime agricultural land to urban land uses, overdraft of groundwater resources, conversion of agricultural water uses to urban water uses, increase in the nonpoint source production of water pollutants which may enter surface or groundwaters, and greater demand for utility and social services. There are programs and regulatory processes in place that are separate from the Master Project with the responsibility and authority to mitigate these impacts of growth. The scopes and efficiencies of these programs are not the subject of this Draft EIS.

The resolution of issues and the mitigation of adverse impacts directly relatable to the Master Project alternatives are within the purview of the EPA, DOI, NDEP, and the Cities of Reno and Sparks. Each alternative brings with it significant problems relative to gaining implementation. The situation of Alternative L-1 as recommended in the Draft Facilities Plan compared to other alternatives is:

- It is the least costly to Reno and Sparks for construction and for operation and maintenance. It should be noted that the estimated costs do not include the costs for mitigating the significant adverse impacts. Implementation costs are not a part of any of the alternatives.

- Although it removes the direct discharge of JWPCP effluent from the river, a significant nutrient and potential pollutant load is returned to the lower Truckee River via seepage and direct turn out from the canal. The total nitrogen load is greater than that for AWT treatment and river disposal. Among the alternatives only land disposal at Dodge Flat completely removes the discharge of JWPCP effluent from the river, and even with this alternative there may be groundwater returns to the Truckee River. This condition is a significant issue to the Paiute Indian tribe, the DOI, the EPA, and others. Neither the kind of action nor cost for mitigating the potential adverse impacts are included in the Draft Facilities Plan.

- The direct discharge of effluent to the Truckee Canal can account for up to 60 cfs or 42,000 AFY of the TCID water allotment from the Truckee-Carson River system. This action may constitute a change in point of diversion and require a technical change in the TCID water permit. The full nature of this possible requirement for implementation is undefined at this time. Other than a change in point of diversion, no other water right change may be required. This problem is unique to this alternative, and it has not been resolved. Water right changes are not required to implement AWT treatment and river disposal, but water rights of about 12,000 AFY may have to be acquired to implement land disposal.

- Both the Truckee Canal Alternative (L-1) and alternatives to dispose of the effluent at Dodge Flat (L-6 and L-7) could significantly reduce low flows in the river between Steamboat Creek and Derby Dam. A trade-off for the reduction in flow is improved water quality in this reach of river. It enhances opportunities for fisheries, recreational development, and the use of treated river water for domestic water supply.

- Land disposal at Dodge Flat (Alternatives L-6 and L-7) would increase the risk of water shortages to the Newlands Project. The loss of 8-9 percent of the water reaching Derby Dam in the river (or the river plus effluent pipeline as in Truckee Canal disposal) reduces the total supply available to all users. Under the hydrologic model criteria the Newlands Project is predicted to suffer greater shortages in dry years than would occur with other alternatives. This raises water rights questions as to just which water users would be affected and to what degree during a drought if land disposal is implemented. No attempt is made in the EIS to resolve this question, which involves complex water right law issues.

- Discharge to the Truckee Canal is expected to cause fish kills in the canal from ammonia, nitrite and possibly chlorine toxicity. The risk would be greatest at low dilutions. The NDW wishes to retain the fishery potential of the canal. Neither of the other disposal alternatives would cause acutely toxic conditions in surface waters. The trade-off in the case of L-1 is a lower cost to Reno and Sparks for treatment. The impact can be partially mitigated by treating to the same level as required for river disposal.

However, during periods of zero or very low river water dilution in the canal, the high concentration of effluent is expected to have chronic toxic effects on fish and other organisms, which are not reasonably mitigatable.

- The Town of Hazen draws a part of its untreated domestic water supply from the Truckee Canal. The direct discharge of JWPCP effluent to the canal raises the level of risk for human infection or contamination from drinking untreated canal water. A similar but lower risk occurs with river disposal near Vista. Land disposal at Dodge Flat on the other hand would significantly reduce the risk to Hazen residents as compared to other disposal options. Actions and costs to mitigate these significant adverse impacts are not identified in the Draft Facilities Plan.

- Domestic water supply wells drawing from the shallow aquifer along the Truckee Canal are affected by water quality in the canal as well as percolating irrigation water. Relatively undiluted wastewater flowing in the canal and seeping into the groundwater may alter groundwater quality and increase the risk of chemical contamination of the domestic wells. Increased levels of nitrate would be expected and contamination from refractive organic chemicals is possible. The possible mitigation of lining the canal may interfere with the recharge of the groundwater and diminish the well water yield. The other alternatives would improve water quality in the canal and have no new effects on groundwater.

- Lahontan Reservoir is one of the most popular fisheries and recreational water resources in the state. Excessive growths of algal and seasonal low concentrations of dissolved oxygen in deeper water are presently degrading its total recreational value. Alternative L-1 would greatly increase the amount of algal-stimulating nutrients entering the reservoir as compared to other alternatives. The increased load of nitrogen and other nutrients is expected to exacerbate water quality problems in the reservoir. Disposal to the Truckee River would significantly reduce the nutrient load while land disposal would remove the total load originating from the JWPCP. Water quality conditions in the lower arm of the Lahontan Reservoir are expected to noticeably improve with land disposal. Mitigation of this significantly adverse impact through the wastewater treatment process would cause this alternative to be less cost-effective than the river and land disposal alternatives.

- The protection of Pyramid Lake to maintain a unique natural resource is a major objective of the federal government and the Paiute Indian Tribe. Disposal to the Truckee Canal offers significant protection to the lake if spills and seepage to the lower Truckee River from the Truckee Canal are eliminated, since the JWPCP waste load reaching the lake would be reduced without changing flow quantity. The problems associated with the potential to turn canal water and JWPCP effluent into the lower river are capable of being mitigated. Although water quality entering the lake with land disposal would be advantageous, the potential to diminish the amount of water entering Pyramid Lake may offset the advantage.

- The canal disposal alternative has the potential to affect the cui-ui by returning wastewater to the lower river. If this were done during treatment plant failure and at the time cui-ui are in the lower river, fish in the lower river could be harmed. The risk for catastrophic events seems low and is mitigatable. The lowering of river flow and potential effects on cui-ui spawning migrations and dispersal opportunities associated with the land disposal option are judged to cause a greater risk. AWT treatment with river disposal does not adversely affect the cui-ui relative to present conditions.

- Opportunities for the recovery of Lahontan cutthroat trout and rainbow trout habitat in the Truckee River have the greatest opportunity for improvement under Alternative L-1, if spills and seepage from the Truckee Canal are eliminated, because water and river sediment conditions would be significantly improved without impairing instream flow during critical seasons. Toxic conditions in the canal may cause the death of trout entering the canal.

Each of the three principal Master Project alternatives has significant advantages and disadvantages. The disposal of effluent to the Truckee Canal as recommended in the Facilities Plan may require the addition of physical solutions to mitigate significant adverse impacts. Several institutional arrangements would also be required, e.g., contracts between Reno-Sparks and TCID, a change in point of diversion of 60 cfs of water, water rights protections between Vista and Derby Dam, protection of the Hazen water supply, protection of groundwaters recharged by the canal, and changes in state water quality standards that protect beneficial uses in the canal and Lahontan Reservoir.

The implementation of land disposal to Dodge Flat requires the solution of complex water rights and river flow problems. Also, the manner in which the agricultural business is to operate is presently undefined.

Implementation of advanced wastewater treatment with disposal to the Truckee River at two locations near Vista seems achievable without affecting water rights or customary downstream beneficial uses. The trade-offs are increased costs for Reno and Sparks; continued excessive algal growths in the river and elevated nutrient loadings to Pyramid Lake; and risks to public health associated with downstream domestic water supplies.

Chapter 6

ISSUES UNRESOLVABLE BY THE MASTER PROJECT

Through the analysis of the viable Master Project alternatives, several environmental issues were found to be in some way related to the Master Project but in such a poorly defined or remote way that actions on the Master Project will not resolve these issues. Issues unresolvable by the Master Project are identified below.

- Increased flows to Pyramid Lake for lake level stabilization or restoration to historic levels
- Increase in existing flows to the Stillwater Wildlife Management area
- Acquisition of a water right for fishery flows below Derby Dam
- High temperatures in the Truckee River below Derby Dam
- Restoration of a year-round coldwater sport fishery downstream of Vista
- Total recovery of the endangered and threatened fish
- Proliferation of package plants in areas outside the year 2000 sewer service area
- Changes in Truckee River water quality at Farad resulting from changes in water quality standards in California and growth in the Tahoe-Truckee area
- Growth in outlying areas of the Truckee Meadows
- Available water supply for the City of Fernley
- Total population in the Truckee Meadows by the year 2000

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Chapter 7

COORDINATION

Comments Received Through Workshops and Meetings

Brief summaries of the major comments made at workshops and meetings are listed below. Minutes of these workshops and meetings are available from EPA, Region IX.

Public Workshops - Held on March 20, 21, and 22, 1979 in Reno, Wadsworth, and Fallon, Respectively

The purpose of these meetings was to discuss the alternatives available to the Cities of Reno and Sparks for the treatment and disposal of their sewage, to solicit comments about the proposed alternatives, and to answer any JWPCP-related questions.

March 20, 1979 - Reno Comments.

- Downstream water rights must be satisfied.
- Why spend the time and money evaluating the Dodge Flat alternative when AWT is available and there are so many water rights problems?
- Wouldn't land application of effluent be considered nonpoint pollution which EPA prohibits under the 208 program?
- What is the necessity of have spawning grounds in the lower Truckee River when there has not been any spawning there for over 60 years?
- Reno and Sparks are going to have to control or stop their growth or they are going to have to spend a lot more money to maintain the quality of living and the quality of the Truckee River.
- Can't growth be limited by limiting sewer capacity?
- Would water meters help conserve water and thus reduce sewerage flows?
- We should clean up the water for the downstream users, although certain people would like to see the river quality drop so the community could grow.

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- What will be the user cost?

Wadsworth, March 21, 1979 - Comments

- We have a right to clean water.
- The water should be cleaned up at Reno. The water comes to Reno clean and should leave Reno clean.
- Will the water quality protect the beneficial uses?
- If there is a process to clean up the effluent enough to discharge it in the river, why are we worrying about land disposal?
- We are concerned about satisfying water rights.
- What will happen to water right priorities during low flows?
- Federal water regulations require the minimum flow to be 30 cfs but now the flow is only 16 cfs in the lower river. Although flow augmentation may seem reliable on paper, what is the assurance that there will actually be water available for irrigation?
- Can EPA freeze Reno's growth until they clean up their effluent?
- Could Reno charge new commercial and industrial users a higher sewer fee (based on the assumption that they are contributing to the need for additional capacity) to partially offset the high cost of AWT?
- The local ranchers are not very concerned about cleaning up their agricultural return flows when the JWPCP is polluting the river a 1,000 times more.
- There is concern about discharge to the Fernley Drain because it flows past the backyards of developments.

Fallon, March 22, 1978 - Comments.

- How are you going to resolve the water rights problems with land application?
- Why not recycle Reno's water? Could the effluent be piped to Verdi and return through the system?
- Will Fallon's domestic wells be affected by the effluent with discharge to the Truckee Canal?

- What will be the effect on Lahontan Reservoir with Truckee Canal discharge?
- Will the water quality protect the beneficial uses?
- Are there heavy metals in the effluent?
- Is the water clean enough to put in Pyramid Lake?

Public Workshops - April 24, 25, 26 held in Reno, Wadsworth, and Fallon, Respectively

This workshop was a follow-up to the March 1979 workshops and was intended to solicit additional comments about the proposed alternatives and answer questions.

Reno, April 24, 1979 - Comments.

- Salts will be leached from Dodge Flat through irrigation and will return to the river through underground storage and thus degrade the river. This has happened in every nonriver-bottom area where land has been irrigated.
- The Truckee River cannot be made to support a viable fishery because it cannot meet the necessary conditions, so why perpetuate the point of trying to make it viable in these reports.

Wadsworth, April 25, 1979 - Comments.

- Is there a way to remove salts from the effluent?
- How do land disposal and leached salts from irrigation affect the fishery?
- From where would water for downstream flow augmentation come with the Dodge Flat or Truckee Canal discharge alternatives?

Fallon, April 26, 1979 - Comments.

- Does the capital cost for land disposal include the cost for buying water rights?
- Fallon is concerned with the physical and biological water quality, not chemical. We are concerned with the effects of salts, phosphorus, nitrogen, BOD and boron on soils, and contamination of wells.

- In order to meet salt requirements, you will have to dilute the effluent or remove it with treatment, which is very expensive. Will Reno ask for a variance on this standard?
- Will there be an odor problem from irrigation with effluent?
- How safe is the effluent for swimming?
- The City of Fallon is gravely concerned with any degradation of water quality or quantity above or below Lahontan Dam by the Truckee River.
- From where will water for flow augmentation come?
- How long will the 40 mgd last?

Comments Received Through Distribution of the Preliminary Draft EIS

Numerous comments on the preliminary Draft EIS were received from various organizations and agencies. These comments were taken into consideration during preparation of this Draft EIS. Commenting agencies, individuals, and organizations are as follows:

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U. S. Water and Power Resources Service

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Nevada Department of Wildlife
Regional Planning Commission of Reno, Sparks, and Washoe County
Washoe Council of Governments
City of Reno
City of Sparks
Truckee-Carson Irrigation District
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Race Relations Center
1029 North Virginia
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Reno Unlimited, Inc.
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Yale Law Journal
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BIBLIOGRAPHY

References

Bonham, Harold F. 1969. Geology and mineral deposits of Washoe and Storey Counties, Nevada. Nevada Bureau of Mines & Geology Bull. 7. Reno.

Brown, Glenn A. 1976. Testimony in U.S. & Pyramid Lake Paiute Tribe of Indians v. Truckee-Carson Irrigation District, et al. April 1976, Reno D.C.

Calif. Dept. of Water Resources. 1974. Evaporation from water surfaces in California. DWR Bull. 73-1. Sacramento.

Calif. Office of Planning & Research, and Calif. Dept. of Water Resources. 1978. The California water atlas. Sacramento. 117 pp.

Calif. Regional Water Quality Control Board, Lahontan Region. Truckee River water quality control plan update. South Lake Tahoe.

__________. 1980. Revised Truckee River water quality control plan update. South Lake Tahoe.

Calif. State Water Resources Control Board. 1975. Water quality control plan report. Sacramento.

Calif. University. 1973. Assessment of biological effects of treated wastewater on the Truckee River: final report. SERL Rep. 73-2. Prepared for Calif. State Water Resources Control Board by the Sanitary Engineering Research Laboratory, Berkeley.

California-Nevada Interstate Compact Commission. 1957. Natural flow of the Truckee River. Report of the Joint Engineering Committee.

Carson River Basin Council of Governments. 1978. Carson River drainage (Nevada) areawide wastewater management planning program.

Carson-Truckee Water Conservancy District, and U.S. Bureau of Reclamation. 1965. Washoe project contract, Feb. 19, 1965; and addition, Jan. 9, 1967. 47 pp.

Cohen, Philip, and O. J. Loeltz. 1964. Evaluation of hydrogeology and hydrogeochemistry of Truckee Meadows area, Washoe County, Nevada. U.S. Geol. Surv. Water Supply Pap. 1779-S-BB.

Cooley, R. C., J. W. Fordham, and J. A. Westphal. 1971. Hydrology of the Truckee Meadows, Nevada. Water Resources Project Rep. 15. Desert Research Institute, University of Nevada, Reno.

Cooper & Associates. 1980. Progress report for alternative methods of effluent treatment and disposal, Reno-Sparks joint pollution control plan facilities plan. Prepared for Kennedy/Jenks Engineers.

Desert Research Institute, and Walters Engineering. 1979. Institutional constraint evaluation of land application sites and water right availability for Reno-Sparks sewerage effluent: final report. University of Nevada, Reno. Prepared for the Cities of Reno and Sparks.

Glancy, P. A., A. S. Van Denburgh, and S. M. Born. 1972. Runoff, erosion and solutes in the lower Truckee River, Nevada, during 1969. Water Resourc. Bull. 8:1157-1172.

Guyton & Associates. 1970. Report on groundwater conditions in Truckee Meadows, Washoe County, Nevada. Austin, Texas. Prepared for Sierra Pacific Power Company.

Hansen, D. A. 1979. A model of the effects of physical factors in the Truckee River on spawning success of cutthroat trout. M.S. thesis, Utah State University, Logan.

Johnson, V. K. 1958. Fisheries management report - Pyramid Lake. Nevada Dept. of Fish & Game, Reno.

Jones & Stokes Associates, and Desert Research Institute. 1980. U.S. water and power resources services hydrologic model for the Truckee River, Nevada. Sacramento. Unpublished results.

Kaiser Engineers. 1973. Water quality survey of the Truckee River, vols. I and II. Oakland. Prepared for Calif. State Water Resources Control Board.

Kennedy Engineers. 1975. Draft facilities plan for expansion of Reno-Sparks joint water pollution control plant. Prepared for the City of Reno.

Kennedy/Jenks Engineers. 1980. Draft master project facilities plan, expansion of Reno-Sparks joint water pollution control plant. San Francisco. Prepared for the Cities of Reno and Sparks.

Koch, D. L. 1972. Life history information on the cui-ui lakesucker (Chasmistes cujus, Cope 1883) endemic to Pyramid Lake, Washoe County, Nevada. PhD. dissertation, University of Nevada, Reno. 354 ppp.

Koch, D. L., and J. L. Hainline. 1976. Benthic macro-invertebrate populations in the Truckee River, Nevada-California, with reference to river flow and water quality. Water Resources Center Project Rep. 41. Desert Research Institute, University of Nevada, Reno.

La Rivers, I. 1962. Fishes and fisheries of Nevada. Nevada Dept. of Fish & Game, Reno. 782 pp.

Lider, E. L., C. J. Bailey, and D. L. Koch. 1980. Algal growth potentials in the Truckee River, Lahontan Reservoir, and Pyramid Lake, Nevada. Bioresources Center, Desert Research Institute, University of Nevada, Reno. 47 pp.

Linsdale, J. M. 1936. The birds of Nevada. Pacific Coast Avifauna No. 23. Cooper Ornithological Club. 145 pp.

McAfee, W. R. 1966. Lahontan cutthroat trout. Pp. 225-231 _in_ Alex Calhoun, ed., Inland fisheries management. Calif. Dept. of Fish & Game, Sacramento.

McLane, Alvin R. 1980. Cultural resources inventory in Spanish Springs Valley, Washoe County, Nevada. Soc. Sci. Tech. Rep. 16. Desert Research Institute, University of Nevada, Reno. 21 pp.

McLaren, F. R. 1977. Water quality studies of the Truckee River. Sacramento. Prepared for Dart Industries.

Moyle, P. B. 1976. Inland fishes of California. University of California Press, Berkeley. 405 pp.

Nevada. Board of Fish & Game Commissioners. 1977. Classification of wildlife. Commission general regulation 1(8). Reno.

Nevada. Bureau of Mines & Geology. 1969. Geology and mineral deposits of Washoe and Storey Counties, Nevada. Bull. 70. University of Nevada, Reno.

Nevada. Dept. of Conservation and U.S. Environmental Protection Agency. 1979. Water pollution control regulations. Adopted by the Nevada Environmental Commission, Carson City.

Nevada. Division of Water Planning. 1978. Water supply report on the Truckee River, summary and recommendations: technical memoranda. 2 vols. Carson City.

Nevada. Division of Water Resources. 1973. Alternative plans for water resource use, Carson-Truckee River Basins. Carson City.

Pacific Environmental Laboratory. 1979. Effects of the Reno-Sparks joint water pollution control plant on water quality of the Truckee River: study report, appendices, and summary. San Francisco. Prepared for the Cities of Reno & Sparks.

Pyramid Lake Paiute Tribe of Indians v. Morton. Decided Nov. 2, 1972; amended Nov. 29, 1972; supplemental opinion Feb. 20, 1973. 354 F.Supp. 252 D.D.C.

The Research Group, Inc. 1977. Legal authority for areawide water quality management in Washoe County and the Truckee Basin portion of Storey County. Denver. Prepared for the Washoe Council of Governments.

Ringo, R. D. 1975. A survey of Truckee River fish passage problems with emphasis on Lahontan cutthroat trout. U.S. Fish & Wildlife Service, Reno.

Rowell, J. H. 1975. Truckee River temperature prediction study. Rev. ed. U.S. Bureau of Reclamation, Sacramento.

Sierra Pacific Power Company. 1976. Water system study and future supply requirements. Reno.

__________. 1979. Truckee Meadows water supply statement. Reno.

Snyder, Jo. 1917. The fishes of the Lahontan system of Nevada and northeastern California. U.S. Bur. of Fish. Bull. 35:33-86.

Sonnevil, G. M. 1977. Cui-ui (Chasmistes cujus) population monitoring: Pyramid Lake, Nevada. U.S. Fish & Wildlife Service, Reno.

__________. 1978. Cui-ui investigations: Pyramid Lake, 1978. Endangered Species Program special report. U.S. Fish & Wildlife Service, Reno.

Trehn, Arnold. 1978. A taxonomic and floristic study of selected aquatic plants of Nevada. M.S. thesis, University of Nevada, Reno.

Truckee River Agreement, between U.S., Truckee-Carson Irrigation District, Washoe County Water Conservation District, Sierra Pacific Power Co., et al. Approved June 13, 1935. 20 pp.

U.S. Dept. of the Interior. 1977. Draft environmental statement of the proposed operating criteria for the lower Truckee-Carson River Basins. Prepared by the Special Projects Office, Reno.

U.S. Dept. of the Interior and U.S. Bureau of Reclamation. 1966. Washoe project, Nevada-California: definite plan report. Reno.

U.S. Environmental Protection Agency. 1971. Water quality data, Truckee and Carson Rivers, Pyramid Lake and Lahontan Reservoir: a working paper. Reno.

__________. 1976. Quality criteria for water. Prepared by Office of Water & Hazardous Materials, Washington, D.C. 256 pp.

__________. 1977. Waste source and water quality investigations, Reno-Sparks joint water pollution control plant and Truckee River. Prepared by the National Enforcement Investigations Center, Denver.

U.S. Fish & Wildlife Service. 1977. Cui-ui recovery plan.

__________. 1979. Restoration of a reproductive population of Lahontan cutthroat trout (*Salmo clarki henshawi*) to the Truckee River/Pyramid Lake system: preliminary special report. Reno. 131 pp.

U.S. Geological Survey. 1979. Water resources data for California, water years 1900-1979. U.S.G.S. water data report.

U.S. National Oceanic & Atmospheric Administration. 1978. Local climatological data, annual summary with comparative data: Reno, Nevada. Prepared by the National Climatic Center, Asheville, N.C.

U.S. Soil Conservation Service. n.d. Soil survey for Spanish Springs Valley. Preliminary unpublished data available from the Reno Office.

U.S. Soil Conservation Service and U.S. Forest Service. 1972. Water and land-related resources - central Lahontan Basin, Truckee River subbasin, Nevada-California: interim draft report.

URS Company. 1977. Urban and agricultural non-point waste loadings to the Truckee River. Las Vegas.

__________. 1978a. Agricultural runoff control manual for the Truckee River Basin. Las Vegas.

__________. 1978b. Alternative programs for reducing urban storm runoff pollution from the Reno-Sparks area. Las Vegas.

__________. 1978c. Truckee Meadows wastewater management study: preliminary. Las Vegas.

__________. 1978d. Water quality impacts of pollutant loads upon the Truckee River. Las Vegas.

__________. 1979. Wastewater reclamation feasibility study. Las Vegas. Prepared for Washoe Council of Governments.

Washoe Council of Governments. 1978a. Truckee Meadows air quality implementation plan. Prepared for the Intergovernmental Air Quality Task Force, Reno.

__________. 1978b. Washoe County 208 water quality management plan. Prepared by the Dept. of Regional Planning, Reno.

Wolcott, R. S. C. 1978. Evaluation of the 1978 Lahontan cutthroat trout run to the Pyramid Lake fishway and comparison with past years. U.S. Fish & Wildlife Service special report. Reno.

Personal Communications

Barngrover, Larry. September 1979. Manager of Fernby Wildlife Management Area, Nevada. Nevada Dept. of Wildlife.

Crowe, Leonard, Jr. April 2, 1980. Project Manager, Washoe County 208 Program. Washoe Council of Governments. Memorandum.

__________. May 5, 1980. Memorandum.

Firth, Robert. 1979-1980. Water Resources Division, Sierra Pacific Power Company.

Freitag, Paul. July 24, 1980. Attorney for Aqua-Terra, Inc., Reno.

Galat, David. 1979-1980. Pyramid Lake Project, Colorado Cooperative Fishery Research Unit. Fort Collins.

Helseth, Larry. 1979. Accountant. Hidden Valley Water Company.

Herron, Gary. April 16, 1979. Biologist. Nevada Dept. of Wildlife. Letter to Russell Askew.

__________. January 1980.

__________. Feburary 1980.

Koch, David. February 1979. Bioresources Center, Desert Research Institute, University of Nevada, Reno.

Le Fever, Morris. July 1979. Manager, Stillwater National Wildlife Refuge. U.S. Fish and Wildlife Service.

Meiercierck, Jay. February 1980. Nevada State Park System.

Mollini, Willie. February 1980. Chief of Habitat. Nevada Dept. of Wildlife.

__________. September 9, 1980.

Strong, Wally. December 1979. Planning Director. Pyramid Lake Paiute Indian Tribe.

__________. February 1980.

Sumner, Robert. February 7, 1980. Nevada Dept. of Wildlife. Memorandum to Andrea Darling, Jones & Stokes Associates.

Thorp, Michael. May 8, 1980. Attorney for Pyramid Lake Paiute Indian Tribe. Letter to Thomas R. Severino, U.S. EPA, Region IX.

Weil, Steve. August 6, 1979. S. Wiel & Associates. Memorandum to Charles R. Breese, Jr., Executive Director of Washoe Council of Governments.

Wolcott, Roger. January 1979. U.S. Fish and Wildlife Service.

APPENDICES

There are 11 appendices to the EIS, covering the following topics. The appendices are bound in three volumes, containing Appendices A-D, E-G, and H-J, respectively. Interested readers may order one each of any or all of the volumes that are of interest to them. These should be ordered from:

Mr. Thomas Severino, Project Officer
U. S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, CA 94105

Appendix A - Regional Economy, Future Population Growth and Housing

This appendix discusses the following topics: the Reno economy; Reno's economic future; future population growth, including population projection and forecasting techniques, and forecasts of employment growth in the State of Nevada; and housing Reno's future growth.

Appendix B - Air Quality

This appendix includes the following information: meteorology data of the Truckee Meadows area; air quality monitoring data of the Truckee Meadows; and emissions forecast for the Truckee Meadows.

Appendix C - Water Law and Water Rights

This appendix discusses the following topics: institutional constraints affecting Truckee River water rights, including discussion and case briefs of major judicial and agency actions and institutional constraints affecting the Master Project, including the Endangered Species Act, state and federal water law principles, California-Nevada interstate water compact, court decrees, administrative actions and current litigation.

Appendix D - Cultural Resources Survey for the Master Project

This appendix discusses the historic and prehistoric background of the study area, discusses the results of a 10 percent cultural resources survey of lands potentially disturbed by Master Project alternatives and identifies potential mitigation measures for adverse impacts.

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Appendix E - Surface Water Hydrology

This appendix discusses the following topics relating to surface water hydrology: climate; Truckee River flow characteristics; historical flows; diversion; consumptive uses; and M&I use.

Appendix F - Surface Water Quality

This appendix discusses the following topics relating to surface water quality: water quality standards; historical water quality; various water quality studies conducted by private and governmental agencies; existing water quality; and major pollutional inputs to the Truckee River.

Appendix G - Hydrologic Modeling

This appendix discusses the hydrologic modeling that was undertaken to identify Truckee River flow and quality changes that could result from Master Project alternatives. The appendix presents the assumptions and conclusions of the modeling; the land use assumptions developed to predict declines in agricultural land use resulting from projected urban growth; urban water use assumptions; and material supplementing the results published in the EIS.

Appendix H - Limnology of Pyramid Lake and Lahontan Reservoir

Topics discussed in this appendix include physical, chemical and biological characteristics and major ecological concerns regarding Pyramid Lake and Lahontan Reservoir.

Appendix I - Endangered and Threatened Species

This appendix discusses the life history, habitat requirements, reasons for decline, physical and biological factors necessary to restore natural populations and present efforts to restore the endangered cui-ui and threatened Lahontan cutthroat trout.

Appendix J - Fish and Wildlife Resources

This appendix discusses the life histories of fishes found in the Truckee River from Verdi to Pyramid Lake and identifies wildlife species found in the study area.

Appendix K - Background Agreements and Permits

Background agreements, permits and administrative actions pertinent to the Reno-Sparks JWPCP Master Project are included in this appendix.